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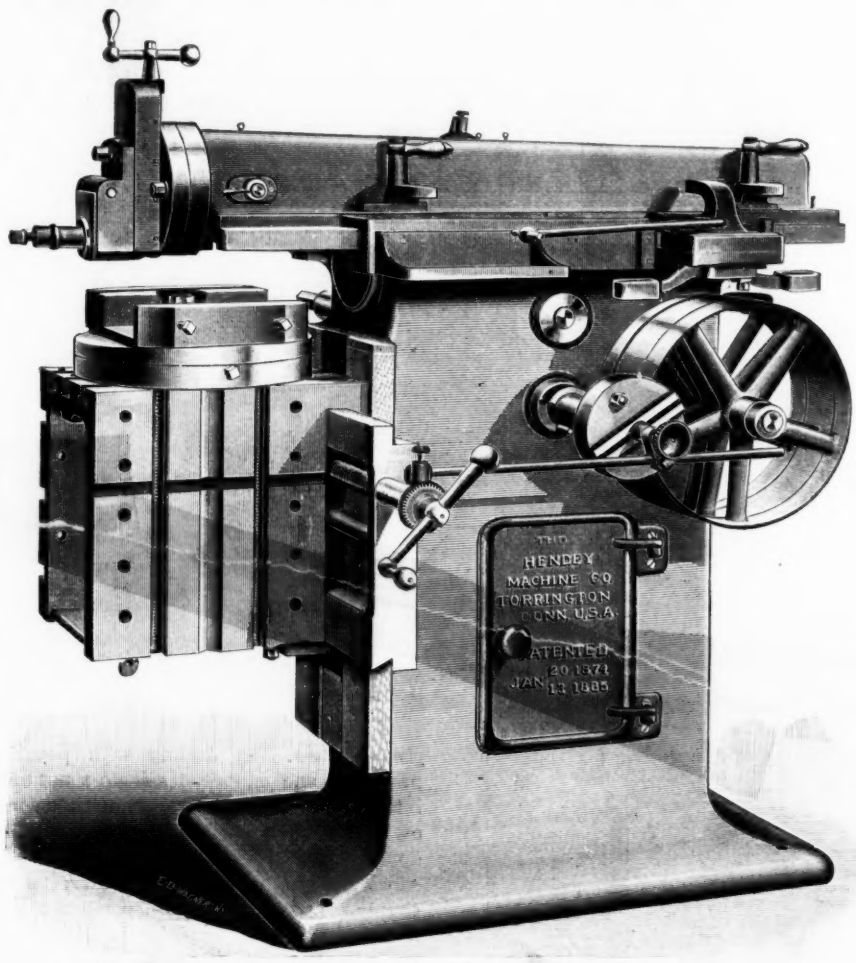
Twenty four-inch Belt-shifting Shaper.

The illustration is of a belt-shifting shaper made by the Hendey Machine Co., of Torrington, Conn., and is the same in every way as their well-known friction shaper, of the same size, except that it is driven by shifting belts instead of the regular friction device as used by them.

The machine has vertical as well as cross feed, worked by power, and is a strong and heavy machine with many improvements as shown in the cut. It has a stroke of 24″, a cross feed of 23″, and will plane a piece 18″ high. The table is of the box form, and with the crosshead is very large and heavy. The weight of the machine is 2,400 pounds.

Heavy Turret Lathe.

The accompanying engraving is of a new turret lathe, which has recently been brought out by the Lodge & Davis Machine Tool Co., Cincinnati, Ohio. It is designed especially for the heaviest work adapted to be done by this method, such as is done on large valves, etc. The head is provided with a friction clutch which allows the back gears to be thrown into or out of action without stopping the machine. The feed is either by hand with the pilot wheel shown, or by power through the feed rod, this feed being engaged or reversed at the carriage. The turret, which is 16″ diameter, revolves automatically. There is an automatic stop for the feed, which stops it at any desired point. Cabinet legs which are arranged for the reception of tools and fixtures, and the usual features for controlling the flow of oil, are provided.



TWENTY-FOUR-INCH BELT-SHIFTING SHAPER.

Boiler-feed Pumps, World's Columbian Exposition.

In most large boiler plants the feed pumps are stowed away in the corners or hidden under the floor. At the World's Columbian Exposition the feed pumps and heaters will be a very prominent feature in the power plant. The pumps occupy nearly as prominent a part of the boiler house as do the boilers themselves. They extend in a line the entire length of the boiler house, just in front of the visitors' gallery. The feed-water heaters will be placed on the visitors' gallery in sections set apart for them.

It will be remembered that the visitors' gallery extends along the dividing wall between Machinery Hall and the boiler house, and that the boiler house floor is below that of Machinery Hall and the gallery (9 feet).

As a rule the pumps are arranged in pairs, with water ends toward each other. Each pair is located directly across from the boilers they are to feed, and the pumps are set upon concrete foundations two feet high, which will make them still more easily seen from the gallery.

The piping for these pumps will be quite complex, there being two and possibly three distinct sources from which the feed water will be taken. First, from the water mains of Jackson Park; second, from the overflow condenser pipes; third, it may be taken from the condenser supply pipe.

Cross connections will be so arranged that any pump may take water from any source and force it direct, or through an exhaust high-pressure heater to its boiler; or it may draw its supply through a low-pressure heater and force it direct to the boiler.

Steam will be taken from the 36″ main steam heaters which extend under the visitors' gallery.

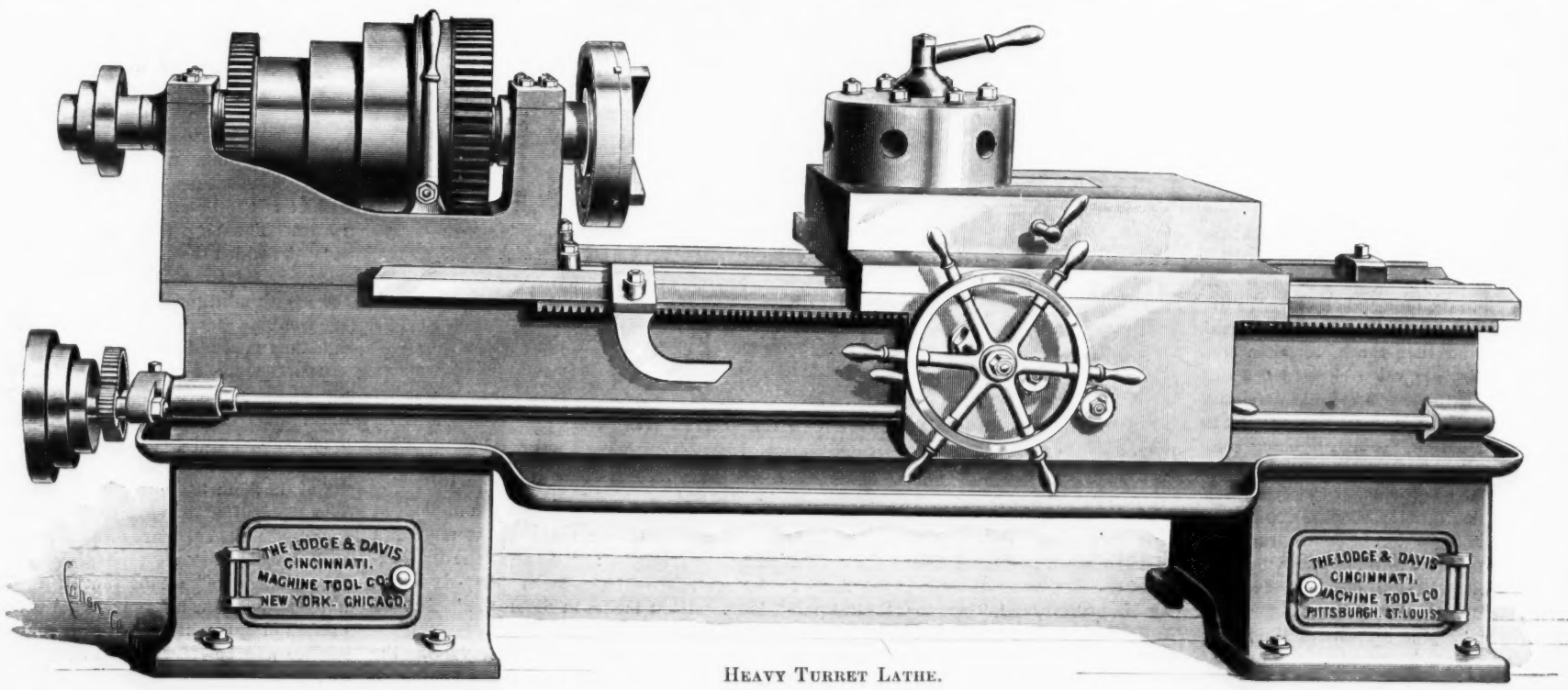
The boilers already contracted for are guaranteed to develop 15,000 horse-power. From the manufacturers' figures the pumps arranged to feed them can supply water for fully 60 000 H. P.

These pumps represent many different firms, and are arranged as follows: For Heine boilers, two Knowles 10x5x12, two Blake 8x5x12; Root boilers, two Deane 7½x4½x10, and one McGowan 8x5½x10; National, two Davidson 12x20x20; Gill, two Barr 10x6x10; Campbell & Zell, A. S. Cameron, 8x4x12; Canton, 8x5x–; Laidlaw & Dunn, 7½x4½x10; Wilson, Snyder Co., 14x8x18, and Babcock & Wilcox three Snow 8x12x7x12, 10x6x10, 8x5x10.

Most of the above pumps are already on the ground, and several are on their foundations.

World's Columbian Exposition.

To a casual observer of the work at Machinery Hall it would appear that more had been accomplished during the last two weeks than ever before in an equal length of time. This is true because the installations of the engines shows up better, and is certainly far more interesting than the foundations.


THE LODGE & DAVIS CINCINNATI. MACHINE TOOL CO. NEW YORK. CHICAGO.
THE LODGE & DAVIS CINCINNATI. MACHINE TOOL CO PITTSBURGH. ST LOUIS

HEAVY TURRET LATHE.

A number of the smaller engines have already been put in place, and the main castings of the 500 horse-power Russell engine are on the foundation, ready for the machinists to bolt them up.

The floor in the power plant is being rushed. This floor will be sufficiently strong to carry the heaviest engine castings with safety. It is of 3" oak, supported upon 8"x 16" girders and 4"x12" joists, both of oak, all upon 10"x10" posts. The joists are "stirruped" to the girders and run parallel to the belts, so as to allow the cutting of belt holes with the least amount of patching.

The steam and exhaust piping will follow close upon the completion of the oak floor. Then with the steam headers practically completed, and the Root and Gill boilers all ready for the test, it will be but a very short time before many of the smaller engines can be given a trial run.

Jackson Park, December 30, 1892.

Steel for Files.

John Richards says in his *Industries:*

"Mr. Albert D. Pentz, who is a good judge of the matter, says American files are below comparison with the Swiss and some other foreign files, which is a truth of fifty years' standing, and we fear is likely to remain one unless machine processes can be made to supplant painstaking hand skill; but there is another phase of the matter. Mr. Pentz says that, from some inquiries made, he concludes that in one case, at least, the steel used for American files was bought, or could be bought for four cents a pound. This is dishonest and disgraceful. There is no steel fit for common files that can be bought at twice this rate, and none for fine files at three times the rate. This matter of files is one of unhappiness to all who purchase or use them, and places us at a great disadvantage in some kinds of manufactures. If there is no skill or enterprise to produce good files there should be no impediment to buying foreign ones. We hardly think, however, the case is as bad as represented."

Every machine shop and tool room should have, hanging on the wall, near the foreman's desk, or elsewhere, one of Kearney & Foot's A B C file charts. This is a chart designed especially for machine shop walls, and gives life-size pictures of all the leading shapes of files in outline, these being filled in with engravings of different cuts made of that form. Correct names of these are given, and also useful suggestions as to the purposes for which they may be most advantageously used. The chart is mailed to any address on receipt of 10 cents for postage by the Kearney & Foot Co., Newark, N. J.

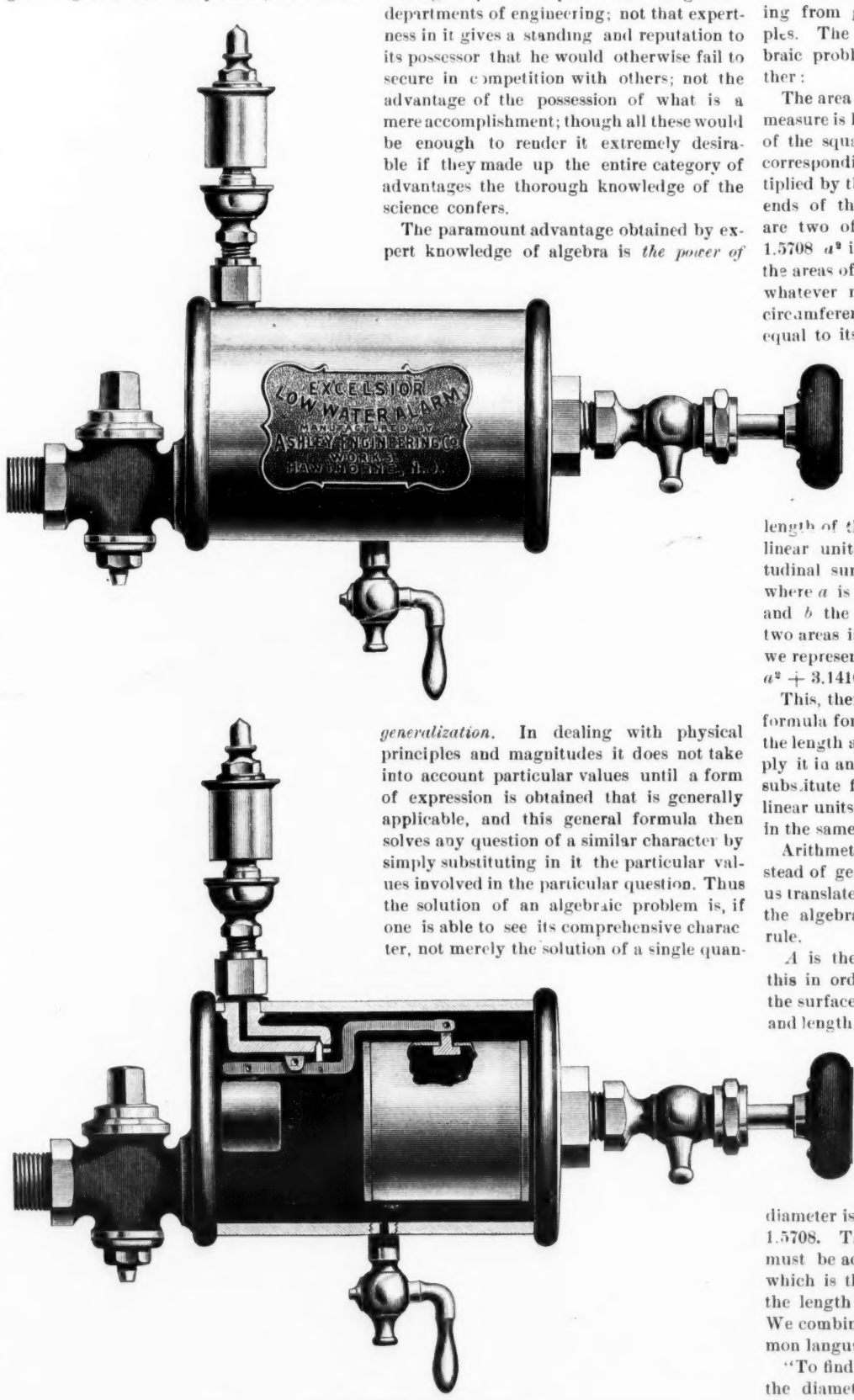
A New Counterbalanced Low-water Alarm.

We illustrate herewith a low-water alarm for boilers which has a new, and, we think, important feature, by which the troubles arising from hollow floats which are intended to be filled with air only, but which in use often become filled with water and thus defeat the object of the float, are avoided. In this alarm the hollow float is open at the top and is intended to be always filled with water. It is attached to the long end of a lever to the other end of which is attached a solid weight which is heavier than the hollow one and will keep the whistle valve closed when the water fills the entire case and hollow weight; which it will when the water in the boiler is at the proper height, the alarm being connected to the boiler at the low-water line. Should the water in the boiler fall below this line, the opening into the boiler is exposed to the steam, and the water, of course, runs out of the alarm cylinder into the boiler, but the hollow float being left full of water, it is then heavier than the solid weight and opens the whistle valve, keeping it open till the water rises to its proper height again.

There is but one opening into the boiler, and the device is quite small and neat in appearance. A gauge-cock can be fitted at the outer end, as shown, and there is a pet-cock at the bottom, by which sediment can be blown out and the working of the alarm tested.

This test is made in the following manner: The alarm being full of water, the plug cock between it and the boiler is closed and the pet cock at the bottom of the alarm opened until the water is blown out of the cylinder or casing. It is then closed, when the water contained in the hollow weight not only opens the valve by its weight, but, being nearly at the temperature of the water in the boiler, it by evaporation supplies the pressure of steam necessary to blow the whistle; and thus the working condition of the device is completely tested.

It is manufactured by the Ashley Engineering Co., 136 Liberty street, New York.



COUNTERBALANCED LOW-WATER ALARM.

Algebra for Mechanics.

BY LEICESTER ALLEN.

I have recently conned over quite a number of articles, some of them in the AMERICAN MACHINIST, and others in technical publications of a different character, which articles discuss variously the great value of algebra as an educational equipment; the uselessness of it; the advantages it confers upon those expert in it; the claim that simple arithmetical processes will solve any problem that can be solved by algebra, etc., pro and con; it being evident, however, through all this discussion, that those who wrote disparagingly of algebra knew nothing about it, while of those who wrote in its favor not a few failed to evince an adequate perception of the true inwardness of algebra, and hence did not bring out the strongest argument in favor of this noble branch of mathematical science.

The greatest advantage of algebra is not that it enables what otherwise would require a cumbrous expression of a mathematical truth to be conveyed in the more concise and convenient language of algebraic symbols—not that it saves a great deal of time that would otherwise be consumed in the solving of practical problems arising in all departments of engineering; not that expertness in it gives a standing and reputation to its possessor that he would otherwise fail to secure in competition with others; not the advantage of the possession of what is a mere accomplishment; though all these would be enough to render it extremely desirable if they made up the entire category of advantages the thorough knowledge of the science confers.

The paramount advantage obtained by expert knowledge of algebra is *the power of generalization.* In dealing with physical principles and magnitudes it does not take into account particular values until a form of expression is obtained that is generally applicable, and this general formula then solves any question of a similar character by simply substituting in it the particular values involved in the particular question. Thus the solution of an algebraic problem is, if one is able to see its comprehensive character, not merely the solution of a single quantitative question, but of the *entire class of questions involving the same principles.*

Let me illustrate this by an example.

In an arithmetic taken up at random I find the following: "What is the total exterior surface of a cylinder thirty-six inches long and ten inches in diameter?" The answer is 1,288.056 square inches.

A general algebraic problem involving the above as a particular case might be written as follows:

"What is the total area of a cylinder b inches long and a inches in diameter?"

An expert in algebra would understand this to mean, what will be a general expression for exterior surface of a cylinder of any length whatever and of any diameter whatever? the language "b inches long" and "a inches in diameter" meaning algebraically *any length expressed in inches and any diameter expressed in inches.* He would also understand that feet, miles, rods, meters, could be used as units in place of inches, and that the answer (formula) when obtained can be used for any denomination of linear measure, the answer for any particular case included in the general formula being in corresponding units of square measure.

Now the algebraic problem excludes all consideration of specific values, and thus unlimbers the mind for free action in reasoning from general and fundamental principles. The following solution of the algebraic problem will illustrate this still further:

The area of any circle in units of square measure is known to be equal to the product of the square of the diameter (expressed in corresponding units of linear measure) multiplied by the decimal fraction 0.7854. The ends of the cylinder are circles, and there are two of them; hence $2 \times 0.7854\ a^2 = 1.5708\ a^2$ is the expression for the sum of the areas of the two ends of any cylinder, whatever may be its diameter. Also the circumference of a circle is known to be equal to its diameter in linear units multiplied by the factor 3.1416; and as the surface of any cylinder, leaving out the end surfaces, is known to be (in units of square measure) the product of the circumference (expressed in corresponding units of linear measure) multiplied into the length of the cylinder expressed in the same linear units, the expression for the longitudinal surface of a cylinder is $3.1416\ a\ b$, where a is taken to represent the diameter, and b the length. Also the sum of these two areas is the total area required: and if we represent this by A we have $A = 1.5708\ a^2 + 3.1416\ a\ b$.

This, then, is the general expression or formula for the surface of *any* cylinder when the length and diameter are known. To apply it in any particular case we have only to substitute for a the *particular* diameter in linear units, and for b the *particular* length in the same linear units.

Arithmetic deals with particular cases instead of generalizing as algebra does. Let us translate the general formula obtained by the algebraic method into an arithmetical rule.

A is the thing to be found. We express this in ordinary language thus: "To find the surface of a cylinder when its diameter and length are given." The sign (=) meaning "*equal to*" or "*equals*" in the formula, shows that the surface sought is the expression to the right of the sign, which consists of quantities and indicated operations. a represents the diameter, the term $1.5708\ a^2$ means that the square of the diameter is to be multiplied by the number 1.5708. The sign (+) means that to this must be added the succeeding or last term, which is the product of the diameter into the length multiplied by ths number 3.1416. We combine these several meanings in common language as follows:

"To find the surface of a cylinder when the diameter and length are both given in linear units of the same kind: Square the diameter and multiply the square by 1.5708. To this product add 3.1416 times the product of the diameter multiplied by the length. The sum will be the surface sought in corresponding units of square measure."

The phrase "corresponding units of square measure" means that if the linear units used are inches, the surface will be expressed in square inches; if linear meters the surface will be expressed in square meters, etc.

We have here seen the genesis of an arithmetical rule; and it may be added that a large proportion of arithmetical rules, particularly those of involution, evolution,

mensuration and position have been born of algebra. Those who are accustomed to use or teach both algebra and arithmetic will back me up when I assert that no one ever yet fully understood the process of extracting roots, without first knowing and understanding the binomial formula (pure algebra) from which the arithmetical rules for these operations are derived; and all algebraists will unite in asserting that any one handy in the use of the binomial formula needs no arithmetical rules for the extraction of any particular root, as the general formula includes every possible case. I should not consider a youth well instructed in algebra unless competent to apply this formula to the extraction of any root of any real quantity.

It is thus seen that arithmetic, as embodied in modern text-books, could not have existed without algebra. I may add that to algebra we are indebted for logarithms, those wonderful labor savers whereby some mathematical operations that would otherwise take a year to perform, and which are of vital import in modern engineering, may be completed in a few minutes. As an example of such an operation, I will cite the determination of volumes corresponding to pressures in the adiabatic compression or expansion of air, wherein such expressions occur as the following: $\left(\frac{1}{7}\right)^{0.7093}$ meaning that the fraction $\frac{1}{7}$ is to be raised to a power indicated by the exponent 0.7093; or, otherwise, that the 10,000th root of the 7,093d power of $\frac{1}{7}$ is to be obtained. To perform this operation without logarithms, though not theoretically impossible, would be so tedious and so liable to inaccuracy that a man's hair would be likely to turn white before he finished it. By the use of logarithms it can be done in ten minutes or less on half a sheet of small note paper. But no one ever understood the true inwardness and scope of logarithms without algebra, and, indeed, it could not be possible, since the construction of a table of logarithms involves the refined algebraic process of solving exponential equations.

It is known to all physicists and mathematicians that up to the time of Newton and Leibnitz there was a large group of mathematical and physical problems that had never been solved, and that up to that period had been found impossible to solve. These problems were, many of them, of great importance to astronomy, navigation, geodesy, steam engineering, civil engineering and mechanics. Without their solution we could never have had a true mathematical theory of the motions of the heavenly bodies; we never could have known how to apply strict mathematical analysis to the expansion of steam, air or other gases, or vapors, so essential to the present advanced state of the arts of steam engineering and pneumatic engineering; a correct strain sheet for such a magnificent bridge as hangs suspended between the two great cities of New York and Brooklyn could not have been drawn. The modern methods of computing the elements of a trajectory of a projectile would have been unknown to us.

Two great men, whose names will live while the world stands, set themselves to devise mathematical methods whereby these urgent needs could be met. Working independently, they brought to the knowledge of the world the two most powerful mathematical engines, so to speak, wherewith to penetrate some of the deepest mysteries of nature. They gave to the world the differential and the integral calculus. Both these branches of mathematics are an extension of algebraic methods to the discussion of fluctuating or variable quantities. Without algebra no calculus would have been possible.

I have heard a mechanical engineer—a pretty good one, too—say, "I never knew anything about the calculus, and I never found any instance where I required it." Not long afterwards, in the shop where this gentleman presided as superintendent of the drawing room, it became necessary to calculate the precise velocity that a mass of iron moved on slides by a crank and pitman would have at a particular position when moving as stated; the object being to determine the living force stored up in it at that point. Search was made in such books as could be mustered for a formula whereby the problem could be solved. The formula was not forthcoming. Various guesses were in progress, when a young graduate of a well-known technical school handed to the superintendent a slip of paper whereon was written the solution, performed by the methods of the calculus.

"But," questioned the superintendent, "can't you do this in some other way, say by common algebra or arithmetic?"

"I don't think it can be done by any other method than the one I used," replied the young mathematician.

"Acknowledge," said I to the superintendent, "that, for once, a knowledge of the calculus would have been of advantage to you. Even if you had found a formula or a table that would have enabled you to determine what you sought, the formula or the table would have been possible only through the aid of what you have hitherto regarded as useless to you. The fact is that nine-tenths of all the formula you use in this drawing room, taking them in simple trust from engineering text-books, have been wrought out by algebraic processes, searching many of them, into the methods of the calculus. If you had a knowledge of these methods you could both check the accuracy of the formulæ you use, and, in a case entirely out of the common run, you could construct your own formula."

"Keep's Tests" for Cast-iron—III.

BY W. J. KEEP, DETROIT, MICH.

FLUIDITY.—Iron may be very thinly liquid, and may freeze quickly, or it may not be so fluid, but by remaining liquid longer will fill the mold better than the former.

It is a very difficult thing to measure fluidity, and it is a question whether we can measure it.

So far as we are aware, the method here described is as satisfactory as any. Use a pattern one foot long, one inch wide, and $\frac{6}{100}$ inches thick, and run it from the end (see the thin bar in Fig. 23). It is a rare thing for the bar to run its whole length.

The length of the casting in inches is the measure of fluidity, and is no doubt a true measure for that particular cast, but the results are unsatisfactory if we try to find

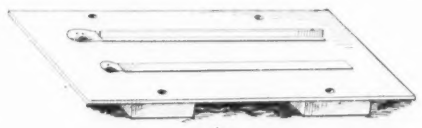


Fig. 23.

which of several mixtures of iron are the most fluid, as the heat of each at time of pouring will vary. In the study of grain and chill this strip may be of considerable value, it being so thin that by breaking it the tendency to chill will be very apparent.

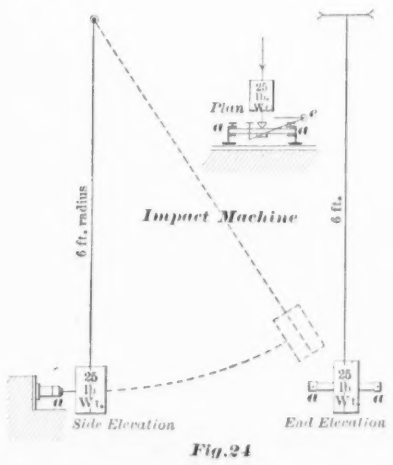


Fig. 24

The lengths that the fluid strip is gray, where chill begins, and where it becomes all white, are sometimes recorded.

CROOK.—Along with the fluid strip, but poured by a separated gate, is another strip of the same dimensions as the fluid strip, but with a rib on one side (see Fig. 23). The distance that the rib has pulled the ends of the bar away from a straight line is the crook. To measure it an appliance is added to the measuring table. In the study of grain this strip brings out many peculiarities. In making these strips the greatest care must be taken to have the castings exactly like the pattern. The use of either of these tests is not recommended.

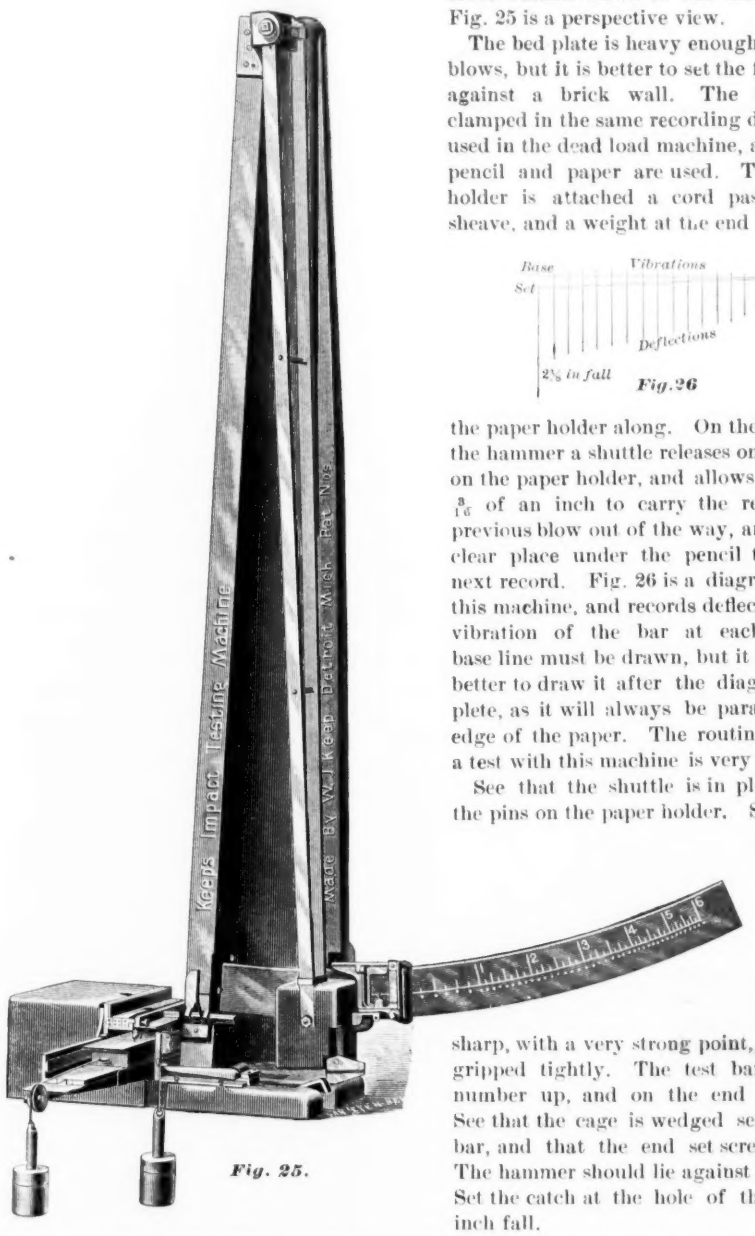


Fig. 25.

THE MEASURE OF STRENGTH BY IMPACT.—The effect of a dead load increased gradually until fracture takes place has been described. Metals are often used in places where they must resist shock.

The effect of a blow cannot be ascertained from the results of a test with a dead load. An iron may be able to sustain a great dead load, and yet break under a comparatively light blow, and *vice versa*. If you wish to know its resistance to impact, you must use a machine especially constructed for the purpose. Blows from a sledge repeated on a casting cannot be delivered at the same spot or with equal force, and in any case the break occurs on account of injury to the grain. The ordinary method of testing car wheels by letting fall a weight in a sort of pile driver on the hub may not injure the grain, and, if so, is a satisfactory test for wheels.

KEEP'S IMPACT TESTING MACHINE.—For testing the standard half inch square bars by impact, where we cannot know how much of a blow the bar will bear, the center of the bar is protected so that the grain cannot be injured, and then blows are delivered with a 25 pound hammer, beginning with a fall of one eighth of an inch, and one-eighth of an inch fall is added to each subsequent blow until fracture takes place.

No change in grain due to crystallization can take place during the delivery of such a small number of blows, and reasoning from our experience with the weight machine, probably each blow, short of the one that breaks, makes the bar a perfect spring for all blows less than that one, though this is not exactly true, for the reason that the blows being so sudden, and the rebound being equally sudden, the grain does not have time to adjust itself to the deflection.

The deflection is, therefore, generally greater for the same bars when broken by impact than when broken by dead load. To insure accuracy the 25-pound hammer swings on a six-foot radius. Fig. 24 shows three outline views of this machine, while Fig. 25 is a perspective view.

The bed plate is heavy enough to resist the blows, but it is better to set the forward end against a brick wall. The test bar is clamped in the same recording device as was used in the dead load machine, and the same pencil and paper are used. To the paper holder is attached a cord passing over a sheave, and a weight at the end tends to pull

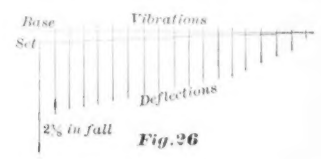


Fig. 26

the paper holder along. On the rebound of the hammer a shuttle releases one of the pins on the paper holder, and allows it to move $\frac{3}{16}$ of an inch to carry the record of the previous blow out of the way, and to bring a clear place under the pencil to receive the next record. Fig. 26 is a diagram made by this machine, and records deflection, set and vibration of the bar at each blow. A base line must be drawn, but it is as well or better to draw it after the diagram is complete, as it will always be parallel with the edge of the paper. The routine in making a test with this machine is very important.

See that the shuttle is in place to release the pins on the paper holder. See that there is a weight on both paper holder and shuttle to hurry their action. See that the pencil is sharp, with a very strong point, and that it is gripped tightly. The test bar lies with its number up, and on the end nearest you. See that the cage is wedged securely to the bar, and that the end set screws are tight. The hammer should lie against the receiver. Set the catch at the hole of the one-eighth inch fall.

Draw back the hammer with the left hand, and catch it on the trigger. This backward movement has worked the shuttle, and has moved the paper, thereby marking the commencement of the base line. With the right hand press the trigger and release the hammer. As it swings forward and strikes a blow, with the right hand move the catch forward on the arc one hole, and with the left hand catch the hammer on its rebound, and bring it up to the trigger. Repeat these blows, increasing each by one eighth of an inch fall; that is, move the trigger back one hole each time until the one inch fall has been reached, at which time you must tighten the cage and set screws. Make this examination after each stroke for even inches is reached, or oftener. Continue in this way until the bar breaks. Read from the arc the height of the fall which broke the bar, and mark it on the diagram. A base line can now be drawn from the beginning already made, and parallel to the edge of the paper. From this line deflection, set and vibration can be measured. When both machines are used, six bars should be made to give an average of three for each machine.

COMPARISON OF RESULTS BY DEAD LOAD AND IMPACT.—If test bars that will take set are used, and it is remembered that for all stresses less than the highest proof stress the bar is a perfect spring, a bar can be tested to a given stress on one machine, and then the recorder with test bar may be transferred to the other machine, and stress applied until set begins, then transfer back again and make another diagram. In this way for a given material it may be found approximately what impact is equal to a given dead load. There is no uniformity of results with different sets of bars from different materials, and the indication is that each

set of bars has a dead load and impact result, dependent upon some peculiarity in the chemical or mechanical composition of such bars, and one cannot be calculated from the other by any formula.

A blow is expressed in inch or foot-pounds (25 x by height of fall), but this cannot be compared with pounds avoirdupois. To be able to make a comparison, some years ago we constructed the following table (Fig. 27), which has been proved perfectly satisfactory where all results are relative.

W. J. KEEP'S IMPACT TESTING MACHINE.

Table showing the number of inch-pounds developed by each blow. Also giving an arbitrary value to each blow in pounds avoirdupois, to allow comparison and tabulating with records from Keep's dead load machine.

The value for an inch-pound was obtained by testing a good sample of Swedish gray pig-iron which broke in the dead load machine with 288 pounds and by impact with a 2¼-inch fall. The table was constructed from this data.

Inches perpendicular fall of 25-lb. hammer.	Inch pounds developed.	Value of each blow in lbs. avoirdupois.	Inches fall of 25 lb. hammer.	Inch-pounds developed.	Value of each blow in lbs. avoirdupois.
0.12	3 12	16 94	3.12	78.12	423 53
.25	6 25	33.88	3 25	81 25	440.47
.37	9 37	50 82	3 37	84.37	457 41
.50	12.55	67 76	3 50	87 55	474 35
.62	15 63	84 70	3.62	90 63	491 29
.75	18.70	101 65	3 75	93 70	508.24
.87	21 87	118 59	3.87	96.87	525.18
1.00	25 00	135 53	4 00	100.00	542 12
1 12	28 15	151 46	4 12	103.12	559.06
1 25	31.25	169 41	4 25	106 25	576 00
1 37	34 38	186.25	4 37	109 37	592 94
1.50	37.41	203.29	4 50	112.55	609.88
1.62	40 61	220.23	4 62	115 63	626.82
1 75	43.72	237 18	4 75	118.70	647.77
1.87	46.87	254.12	4.87	121.87	660.71
2.00	50.00	271.06	5.00	125 00	677.65
2.12	53 13	288 00	5 12	128 12	694.59
2.25	56 25	304.94	5 25	131.25	711.53
2 37	59.37	321.88	5.37	134.37	728.47
2 50	62.55	338 82	5 50	137.55	745 41
2.62	65 63	355 76	5.62	140.63	762.35
2.75	68.70	372.71	5 75	143 70	779.30
2.87	71 87	389 65	5 87	146 87	796.24
3.00	75.00	406.59	6.00	150 00	813.18

Fig. 27.

It must be observed that while the proportions of this impact machine were at first selected arbitrarily, yet it is now necessary to adhere to these proportions to make the results comparable with those which have been obtained and have been published.

EXAMPLES OF DIAGRAMS.—To illustrate what these machines will reveal, some examples of diagrams, both dead load and impact, are produced from cast-iron in Fig. 28, and from a rolled ½-inch bar of wrought-iron (Fig. 29).

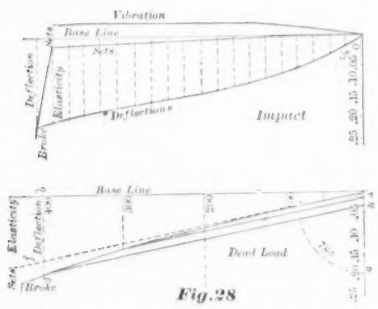


Fig. 28

The full record of a test of pig-iron is given from our record book (Fig. 30). (Where weight or W + occurs it should be dead load, and the column $E \times e$, denoting the distance from the center of the bar that fracture occurred would hereafter be filled with set.)

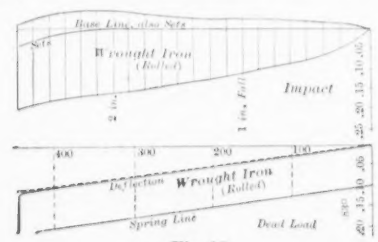


Fig. 29

HARDNESS.—Fig. 31 represents the machine used in "Keep's tests," which was invented by Professor Thomas Turner, Mason College, Birmingham, Eng., and to which we have added some improvements.

At the end of a perfectly balanced arm is fixed a standard diamond which bears upon the polished end of a test bar. By placing gram weights on the diamond until it makes a standard scratch on a standard polished surface, the number of grams on the diamond

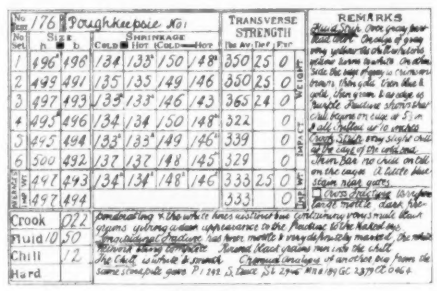


Fig. 30.

point is the number which represents the hardness of the metal. Results depend largely upon the skill of the operator, but are probably more reliable than results obtained by any other method.

THE TESTING OF PIG IRON.—Nothing can be more unsatisfactory than to melt a few hundred pounds of any one brand of pig-iron in a small cupola in contact with the large amount of fuel required, and such remelted iron is entirely unlike the average iron from a cupola after it has become hot. A furnace should be constructed something like a brass furnace, about 30 inches deep and 13 inches square on the inside, with a fire-brick cover which can be easily removed. It must have a tight ash-pit, and must be driven by a fan. The blast may be taken from the same pipe that supplies a forge near by if the blast can be continuous for ten hours during the day. The pressure in the pit should be about 2¼ ounces to give best results. Use the best Connellsville coke and use a No. 16 Dixon's crucible (brass). From five to fifteen pounds of iron will make a test, and the latter will make six or eight pairs of bars. If fifteen pounds of iron is put in in one piece it will melt in from twenty-five to forty minutes. It is well to cover the crucible with the bottom of an old crucible. If the furnace is to be run all day it is best to draw the grate bars and clean out the cinders and ashes at noon. Eight or ten heats can be made in a day, and a crucible will stand forty heats or more.

Enough sand for the whole day's work should be tempered the night before, so as never to use the hot or dried sand. Fig. 6 shows a molder at work, and Fig. 32 shows our furnace and the manner of pouring from the crucible in our testing room.* A good chimney flue must be connected with the furnace just under the cover. The work is so severe that both furnace and chimney must be securely clamped. The furnace lining will seldom last more than four or five days if used continuously. The flame comes out of all cracks, therefore no free oxygen can enter the crucible, and the cover prevents a circulation of gases in the pot.

* When convenient we would advise making the top of the furnace even with the floor, like a furnace in a brass shop.

At best there is considerable variation in duplicate casts from the same iron, but generally the test bars do not materially vary from the pig-iron. It you are mixing several brands of pig-iron in a cupola, and the results are not satisfactory, a test of each brand will generally show which iron is causing the trouble and which iron is the best.

No iron producers can deny the results of such a test. It is well to stipulate when purchasing pig-iron for thin castings that it shall have no chill when melted in this way.

To enable those who wish to aid in the establishment of a standard test for cast-iron to be certain that their test bars and apparatus are uniform with others, if they will correspond with the author of this paper they can be supplied with the following apparatus:

1 set bronze patterns for test bars with iron follow-board; 4 pairs yokes for shrinkage

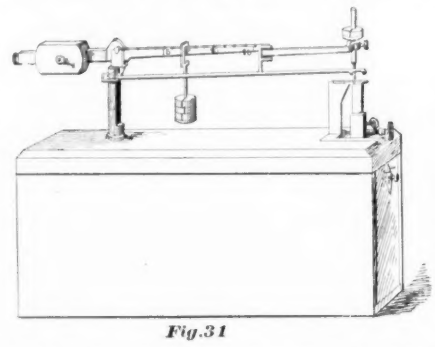


Fig.31

and chill; 1 measuring gauge one hundred to two hundred thousandths of an inch; 1 plate for measuring shrinkage; 1 Keep's dead load testing machine; 1 recorder for dead load or impact machine; 1 Keep's impact testing machine; 1 one-inch micrometer caliper in box; 1 two-inch steel scale; 1 double lens, mounted. The Hardness machine or furnace castings can be made if ordered.

[These articles describing "Keep's Tests" are now complete, but their author informs us that in view of the fact that they lack practical application for those who are unaquainted with tests, he is preparing a short paper devoted especially to foundry mixtures. This will be illustrated by engravings of fractures of bars having different proportions of silicon, and will give results of mixtures used in some of the best known foundries. We expect that this will be a contribution to the subject of iron mixtures, of very unusual value.—ED.]

Fig. 32.

Condition and Prospect of the Machinery Business.

LETTERS FROM PROMINENT ESTABLISHMENTS TO THE "AMERICAN MACHINIST."

C. H. Baush & Sons (Founders and Machinists, Machine Tools), Holyoke, Mass., write us:

We beg to inform you that our business for the past year has been very satisfactory. We have recently completed a large addition to our works, and have the same equipped with a 10-ton traveling crane and other heavy tools. We make a specialty of radial drills, and have recently added the manufacture of boring machines. Our present equipment enables us to build the largest machines manufactured in this line. Our prospects for 1893 look very favorable.

McNaull Machine and Foundry Co. (Manufacturers of the McNaull Universal Radial Drill; Creigh Automatic Knife Grinder; Victor Chill Plows; Cane Mills; Jones' Shingle and Lath Machine; Heating Stoves, etc.), Ronceverte, W. Va., write us:

Trade for this year, especially the last few months, has been very satisfactory. We have been crowding our shops, working thirteen hours a part of the time to fill our orders for drills. Our universal radial drills have met with much greater favor than we anticipated. We expect a good year for '93.

Robb Engineering Co Limited (Engineers, Boiler Makers, Machinists, Iron and Brass Founders, etc.), Amherst, N. S., write us:

A little over a year ago we commenced the manufacture of the Robb-Armstrong engine, having undertaken this new venture with the rather unusual practice (especially for Canada) of starting work with a new design of engine, new tools, and new men, or rather boys, the idea being that it would be easier and better to educate boys to the various parts of the work than to employ experienced workmen previously trained to different work and methods. The work was organized and controlled by an experienced person, and it was not the intention to employ cheap labor, the standard of perfection being placed unusually high, and the workmen allowed to turn out only as much as they could bring to the standard of perfection. The output was at first, of course, extremely slow, but has been gradually increased as the hands became more expert in their various departments. The cost, so far as we can judge, has been much the same as if we had employed skilled operators, as the wages paid have been kept as nearly as possible in proportion to rate of production. As to the result, we may say that we are well satisfied, as we have as yet scored no failures in the engines turned out, and we feel that we are acquiring a force of workmen especially adapted to the work they are engaged upon, having the satisfaction of helping a number of young men to become useful in the highest sense. We do not know that we could recommend this course to other manufacturers, unless they have at command, as we had, the services of a man well qualified to instruct, as well as to design and organize.

The other and older departments of our business, boiler making and general machine work, are flourishing, and the sales increasing year by year. We expect to occupy our new foundry in a short time, which will be equipped with the latest and best appliances for handling our class of work.

Narragansett Machine Co. (Engineers and Machinists; Manufacturers of Light Machinery and Scientific Developing Apparatus; Outfitters of Gymnasiums), Providence, R. I., write us:

The past year has been the busiest we have ever experienced. Our trade in small lathes has been up to the average, but our gymnasium business has gone ahead of previous years. We have furnished during the year the gymnasiums at U. S. Military Academy, West Point; U. S. Naval Academy, Annapolis, Md.; men's and women's gymnasiums at Leland Stanford, Jr. University; Washington and Jefferson College, Washington, Pa; State Normal Schools at Indiana, Pa., Bridgewater and Westfield, Mass.; Y. M. C. A.'s at Trenton, N. J., Grand Rapids, and a host of smaller ones. We are now working on an outfit for the University of Chicago, and the Germantown, Pa., Y. M. C. A. At the first of the year we advanced prices, but as we also offered improvements this step did not decrease our orders, even though there were several parties bidding low in order to "get into business." There has been an increase in the price of materials, but wages remain about the same.

The Albany Steam Trap Company (Return Steam Traps, Pumps and Pump Governors, and Phosphor Bronze Renewable Seat Stop and Check Valves), Albany, N. Y., write us:

The several branches of our business for the past year, 1892, have proved very satisfactory to us. In July last we sold our entire filter business, good will and patents, to the New York Filter Co., of New York City. To fill up the void caused by taking so much work out of our shop, we have been introducing Mr. Blessing's new automatic steam pump and pump governor combined, with flattering success, and have good grounds to hope for a good year's business for our return steam traps, renewable seat

and check valves, as well as for boiler-feed pumps and governors. We shall continue to pay the best of wages, as heretofore, if the tariff reformers will permit.

Bridgeport Machine Tool Works, Bridgeport, Conn., write us:

In the latter part of '91 we felt that the steady increase of our business would warrant an addition to our facilities. We therefore erected during the present year a substantial shop of brick and iron construction with traveling crane facilities and latest improvements in every direction. The business of the year now closing has been the largest in our history, and we have every reason to believe that what has been provided will come in good play during the coming year.

The Canton Steam Pump Co. (Manufacturers of the Miller Duplex Steam Pumps for Boiler Feeding and General Purposes), Canton, O., write us:

Replying to your annual letter of Dec. 10, would state that the year, as a whole, has been a very prosperous one for us. We have completed a full line of Miller duplex inside centrally packed plunger pumps, and have these pumps ready for the market.

At this time we are engaged in removing our works from Canton to Dixon, Ill., where a new company has been incorporated under the title of the Miller Steam Pump Co.; capital stock, $100,000. We have erected new works at that point, of brick and stone, which includes office, machine shop, storehouse for patterns, iron and brass foundries, and we expect to be able to take care of a largely increased pump business next year, and to do a general contract business in our foundry.

Being located near enough to Chicago, we will secure some large contracts that are annually placed by Chicago manufacturers. In about three weeks we will be in running order at Dixon, Ill. The works are modern throughout, a very fine and complete equipage is being placed in both machine shop and foundry, and we will be enabled to turn out a superior quality of work by reason of the same.

The Burton Machine Co. (the Erie Key-seating Machine, Dealers in Iron-working Machinery, Lathes, Planers, Shapers, Automatic Gear Cutters, Upright and Radial Drills; Finished Crankshafts a Specialty), Erie, Pa., write us:

Business during 1892 was good with us until about Nov. 1st, since which time it has been quiet. Inquiries are coming in nicely now, and we have booked orders for three key-seating machines this week, and we think prospects for trade the coming year are bright. We are in larger quarters now, and in better shape than ever to take care of orders promptly.

Boston Gear Works (Gear Wheels and Cutting of Every Description), Boston, Mass., write us:

We take pleasure in saying that the last year's experience in our business has been most satisfactory, and we look forward to a good trade during the year 1893.

We have added somewhat to our facility in heavy gear cutting, and we are now able to cut gears as large as seven feet in diameter. We expect it will be necessary for us to build an addition to our factory before long, and we intend to stock up more on iron gears.

Our new iron gear list, which will contain not only spur gears, bevels, miters, etc., but also heavy chain wheels, we hope to have ready by February next.

Leland, Faulconer & Norton Co. (Manufacturers of Machinery and Tools), Detroit, Mich., write us:

Our business for the past year has been very satisfactory. The crowded condition of our shop has delayed the bringing out of some of our new tools.

We are having new shops built, which we expect to occupy within two or three months. With added facilities hope to be able to both have—and take care of—a largely increased business.

Whipple & Armstrong Machine Co. (Designers and Builders of Special Machinery and General Machine Work), Harriman, Tenn., write us:

The prospects for '93 are good, and we look for a great improvement in our business. Inquiries are coming in concerning our tools rapidly, and there is a general brightening up all around us. Starting almost a new business in almost a new town, as we have, has put us under the influence of dull times more than we otherwise should have been, we believe.

Curtis & Curtis, Bridgeport, Conn., write us:

We are happy to report that the year 1892 has been a most prosperous one for us. Owing to great improvements in our pipe-cutting machinery without a corresponding raise of price, the percentage of profits has been smaller than we would wish, but the business has shown a steady growth, and we have done considerably the largest business in our history. This we consider a sign of appreciation by the public of our goods. Our works have run steadily on 10½ hours time per day, and during part of the time 13½ hours. Although our new works contain four times the floor space of our old factory we are getting much crowded, and we expect to make a large addition in the spring.

Sebastian Lathe Company (Improved Foot and Power Lathes, Tools and Supplies, Drill Presses, Shapers, Machinists' and Amateurs' Supplies, etc.), Cincinnati, O, write us:

At the close of this, our first year's business, we take pleasure in saying that it has been an unqualified success. We have found that the best class of machinery dealers were quick to recognize the merits of well-made modern tools, and the number and character of direct orders has been most gratifying.

The cost of labor and material remain practically unchanged. Competition is perhaps a little sharper, but with our improved methods and modern facilities, together with special tools, we have been enabled to meet competition and to secure all the trade we could take care of, and, now that our business is thoroughly established, we look forward to a most successful year, and we believe that the indications are very favorable for an active business in 1893.

Keystone Engine & Machine Works (Engineering Specialties for Steam Power), Philadelphia, Pa, write us:

We have nothing special to report just at present, any more than to say that within the last month business has assumed a better shape. For some time previous to this we have been very dull. Recently we have been disposing of a vast number of our assorted steam specialties, viz.:

Simpson's centrifugal exhaust heads, Simpson's centrifugal steam separator, oil extractors and pumps.

Are at present quite busy on repairs and alterations. Our expectations for doing business are very good.

We have in some instances enlarged our space pertaining to advertisements, and believe we have derived some benefit from this.

We propose exhibiting all our specialties at the World's Columbian Exposition in Chicago in 1893. We understand the space has been awarded us, and are now preparing our exhibits, catalogues and other printed matter, all of which will come into play at the said exposition.

The volume of business during 1892 has been up to our expectations, and we believe we have done a fair business at a fair profit.

Prospects for 1893 are very fair. This year we have added additional room to our works, and have made some improvements in the way of reducing costs pertaining to the manufacture of our various specialties.

Hilles & Jones Company (Machine Tools), Wilmington, Del., write us:

We have been quite busy during most of the past year, principally on heavy special tools for working plate and shape iron. At this time we are building two heavy double-geared fish plate punches capable of punching six holes 1¼" diameter through 1" thickness of steel at one stroke; a duplex plate-planing machine to plane 32 feet on the side and 8 feet on the end; a set of heavy rolls driven by duplex engines to bend 1½" plate and other special heavy tools. If there is no general derangement of business, owing to a change of administration, we think the outlook is good for considerable business during the next year, although prices remain very close. We have increased the facilities of our plant considerably by the addition of a 10-foot boring mill, turret lathe, portable boring machine, and have had in use about a year a 30 ton three-motor electric traveling crane which handles our heaviest work with great facility.

John L. Kelley (Kelley's Patent Specialties), Erie, Pa., writes us:

My business for 1892 was not as satisfactory financially as the previous year, for the reason (as you will see by my letter head) that I have added several new articles of manufacture, and gone to considerable expense making special tools and jigs so as to be able to meet the closest competition. My new adjustable screw plate is being favorably received. The volume of business was 30 per cent. greater than 1891. Wages have remained the same, and the indications are that they will remain so. I intend building a new shop in the spring if the indications are favorable and will warrant it.

Perkins & Co. (Perkins' Patented Perfected Shingle sawing Machinery, Maud S. Stealer, Michigan Favorite, Grand Triumph, Perfection, Florida, Grand Mogul and King of Rotaries, Bolters, Jack Works, Packing Frames, Wheel Jointers, Saw Gummers, Saw Grinders, Drag Saw Machinery, etc., etc.,) Grand Rapids, Mich., write us:

Our trade this year has been in excess of our trade last year. Our collections have been better, and the general run of our customers has been superior to that of 1891. We therefore are encouraged for our 1893 business.

Again, the orders which we have on our books at the present time are in excess of those we were carrying last year at the same time.

The prospective deals are more numerous, and the class of lumbermen who are going to make investments are of a superior grade to those with whom we had dealings in the past year at this time.

We think that all wood-working machinery will receive an impetus in the coming year, which has not been accorded to it for many years in the past.

We anticipate bringing out many valuable improvements in our line during the coming year, but we are desirous of securing foreign patents, and we do not perceive how we can avail ourselves of the medium of the press to illustrate and describe same, for fear that the article thus put in the newspapers may go to foreign markets, and thereby invalidate patents which we may take out subsequently. This is apparently an injustice to the "American inventor," and holds back many valuable improvements, we believe, in the mechanical world.

In sending out individual machines to customers whom we are acquainted with, we accept but very little chance or hazard of any imitations of the principles of their constructions going into foreign market, and thereby precluding our obtaining foreign custom, but in the general distribution of information pertaining to same, which would be received in a descriptive article that was printed in the paper, our risks would be so greatly enhanced that we are precluded from taking that means of advertising our improvements.

We believe that is a matter that the press should take up with such emphasis as to show those in authority that it were better to have the patent in America separate and independent from the patents in foreign countries, and also, if possible, to bring about such a state of affairs as would permit an American inventor to make his application in American and in foreign countries at one and the same time. The patent should be issued in their respective countries at the discretion and promptness of the respective boards of examiners or men in charge of the respective patent offices; that one patent of a similar machine in a foreign country providing the patent in one country should expire before that in another.

Do you not think that we are right in our conclusions as regards many valuable features being held back for the above reasons?

The Hoggson & Pettis Mfg. Co. (the Sweetland Chuck, the Standard Safety Punch, the Porter Belt Clamp, Knitting and Special Machinery, Cutting Dies, Stamps—all kinds, Stencils and Supplies, Engraving, etc., etc., Organ Stop Knobs and Stems), New Haven, Conn., write us:

We look back on the year 1892 with a good deal of satisfaction. The volume of our business is considerably in excess of any previous year, and though the margins have been smaller the increased amount of business has warranted us in adding considerably to our plant, and we are in much better shape to do an increased business for 1893 than we were to start this year January last. During the year we have replaced our engine with a 75 horse Corliss, and added very largely to our machinery in our different departments, and recently have installed a complete electric light plant. The new line of small machinist tools which we have added has helped increase our business largely, and we have been hard pushed to supply the demand. Our chuck department is full, with good prospects of an increase next year. The same may be said of our other departments.

J. Wyke & Co. (Fine Machinists' Tools), East Boston, Mass., write us:

The first ten months we did a rushing business, but the last two months were not quite so brisk. We have had more call this year than ever before for the universal, screw cutting, center, depth, angle and twist drill gauges advertised in your paper—we have sold 16,000 of these tools in the last five years. The keyseat or splining gauge we placed on the market a short time ago is doing well for a new tool, and is in use in many of the best shops in America and Europe, and from all accounts we can gather it is giving good satisfaction. Some engineers ask us (facetiously) why—as the tool is so simple—we did not give it to them before. It is hard to tell what the year 1893 will bring forth, but we have every reason to believe it will be a good year for us.

The W. C. Leffel Co. (The Leffel Water Wheel and Engine Co.), Springfield, O., write us:

The trade in our engines and boilers during the past year has been very satisfactory, and we look forward to a material increase during the coming season, when we will be able to offer a larger line of engines and boilers to more fully meet the demand of the trade.

The special features of our engines and boilers have commanded the attention of buyers, and, we are pleased to say, have given every satisfaction.

Sibley & Ware (Iron Founders and Machinists, Shafting, Hangers, Power Drills, Wood-split Pulleys), South Bend, Ind., write us:

Our business for 1892 has fully exceeded our expectations.

We have put several sizes of drills on the market, and they have given the best of results, and have also added to our machinery.

We hope 1893 will prove a prosperous year to all concerned; are unable, however, at this time to express what would seem to us an intelligent opinion as to the future.

Standard Tool Co, Athol, Mass., write us:

The year just passed has been one of unusual activity with us. We have been constantly on the push. January 1st, 1892, found us with a large list of unfilled orders; these had to be filled, and a constantly increasing demand for our goods sharply looked after to keep our books clear, and our customers good natured. Vexatious delays in shipping are as trying to the manufacturer as the trade.

Our motto is: Every tool of the best quality and style; nothing inferior. Living up to that standard we are constantly adding new and valuable devices and improving all along the lines, so that to-day in point of excellency our tools are all that the most fastidious machinist could desire. Our sales for the month just passed were the largest in the history of the company.

One year ago we put on the market a new 10-inch rapid-transit monkey wrench, which has been so universally indorsed by esthetic mechanics that we were encouraged to add the 6, 8 and 12 inch to the list. These wrenches are made of the best material, drop-forged steel and steel castings, hardened throughout. The workmanship is A1, no slop work or "good enough" being allowed to pass the inspector. Notable among these wrenches is the 6 inch or bicycle wrench, which was designed especially for the use of cycles, and is by far the most beautiful tool of the kind ever produced. Full length, 6 inches; capacity, 1⅛ inch; nut beam, ⅜x$\frac{5}{16}$; head outside of beam, ⅝; length of sliding jaw, 1¼ inches; knife handle, 2¾x1 inch; weight, 5 ounces. The construction is such that by a slight pressure of the thumb upon the lower part of the nut the same will be disengaged from the screw, when the jaw can be opened or closed; the instant the thumb is removed the nut re-sets itself, and no amount of pressure in use can force the nut out of place or cause the jaw to slip. The nut and screw are practically indestructible; the whole tool is highly polished, nickeled or black. As a protection against fire we have just put in a thorough system of Grenell automatic sprinklers, automatic electric alarm, new hydrants, hose, etc. The prospects for 1893 are unusually bright, and the addition of more tools and room seem to be the only means left us to stem the current of business setting in upon us. In the past month we have been called upon to mourn the loss by death of our late president and treasurer, George T. Johnson, a wise and conservative counselor, warm-hearted and genial man. We have not noted any change in prices of material or products; labor averages one point higher. We fully appreciate the value of the AMERICAN MACHINIST as an advertising medium, as the space we occupy in it will attest, and we wish it God-speed in its endeavor to elevate the American mechanic, who to-day stands the peer of mechanics the world over. Honor to whom honor is due.

The Hayden & Derby Mfg. Co. (Metropolitan Injectors, for Locomotive, Marine, Stationary and Portable Boilers), New York, write us:

We have every reason to feel satisfied with our business during the past year. We have brought out several new sizes of machines and added ejectors to our list, and have got quite a large number of our new locomotive injectors into practical operation, from which we are getting excellent reports, and the outlook for business of 1893 is much more flattering than it was in 1892.

James H. Wells (Machinery, Mill Supplies and Repairs), Tampa, Fla., writes us:

I have been obliged to work over time nearly every week until lately. Am not so busy just now. I have done a good year's business in spite of a competing shop recently established, and my sales have nearly doubled. The demand for shafting straighteners is pretty steady.

The large improvement in the phosphate business, as well as other industries, increases my business, and my prospects are excellent for the future.

Tampa is growing very rapidly.

The Bristols' Mfg. Co. (Recording Pressure Gauges and Steel Belt Lacing), Waterbury, Conn, write us:

We have had to enlarge our plant considerably, and we expect before the new year to build an entirely new and larger plant for the manufacture of our line of recording pressure gauges, and other new recording instruments which we are developing.

Since completing our new line of gauges, which now covers all ranges from 4" head of water to 1,500 pounds per square inch, we have found great difficulty in meeting the demands.

Our steel belt lacing business is continually on the increase, the lacing having become recognized as a staple article. We have secured space in Machinery Hall at the World's Fair for the exhibition of our recording instruments and steel belt lacing.

Fox Machine Co. (Wood and Iron-working Machinery), Grand Rapids, Mich., write us:

We will say first, regarding our business of the past year, that it has been satisfactory in every respect. We have gradually increased our force, and have been obliged to work considerably over-time to keep up with our orders.

We have added several special tools for our special work, have also added eight thousand square feet of floor surface to accommodate our increasing business.

In our universal trimmer department we have had a good year's business. Our exports, however, have not come up to our expectations, owing to a depression in foreign manufactures, caused by strikes, cholera, and the operation of the McKinley bill. Our tools here in the United States are meeting with increased favor, and the improved lines we are bringing out, we think, will be appreciated by our customers.

In the introduction of our new open-side shaper we are meeting with excellent success. We believe there is a good future for a tool of this character. In connection with this we are just putting on the market a 15" crank shaper, which has some new and original points that make it much more convenient and serviceable.

Regarding future prospects, we expect to largely increase our output for 1893, and have now more orders on our books for future delivery than we have ever had previously at this season of the year.

Gage Machine Works, Waterford, N. Y., write us:

Our business for 1892 has been variable—part of the time being over-crowded with orders, and part of the time the reverse. From September 1 to December 1 we were obliged to work over-time. December has been a dull month, but during the last week or ten days have booked orders that will carry us into March. Have also many inquiries, and should say that the prospect for 1893 is fairly encouraging.

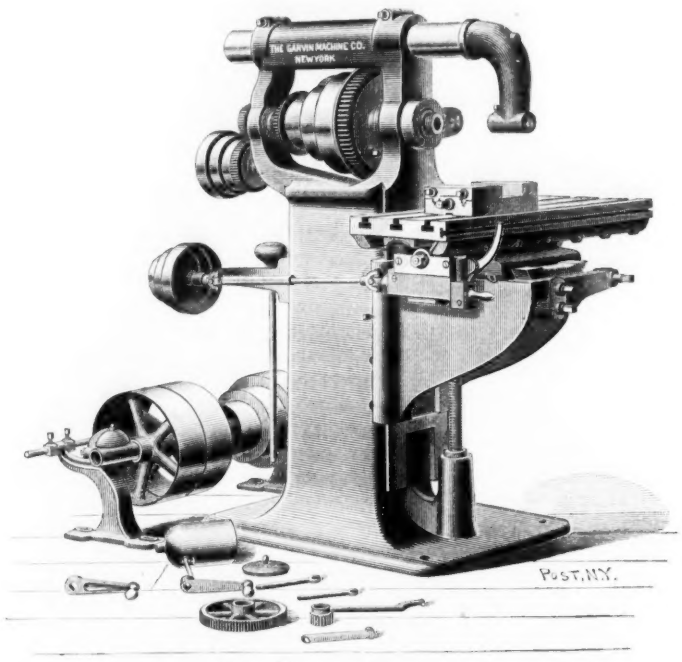
R. M. Clough, Tolland, Conn., writes us:

Business with me has been rather slack the past year, although for election year I think I have no complaint to make. I am about placing a vertical milling machine on the market, which has new and decided advantages over anything in the market and I anticipate having all the business I can do for the next year. The gear cutter trade keeps moving. I am also making a variety of formed cutter mills of various kinds, and improved counterbores, punch and die work, etc. I expect to see good business for 1893, although I think a change of administration will have a tendency to lower prices of material and labor.

A railroad train crashed into a street car recently in Chicago, killing several people and injuring others. The daily press lays the blame to gross carelessness. Why not put it right where it belongs, viz, grade crossings?

New Milling Machine.

We present with this an engraving of a milling machine which has been designed especially for plain heavy work, and, with this in view, has been made simple, direct in its operation, and powerful both in spindle driving and in feed motion, the bearings being also so made as to stand the heaviest usage.



NEW MILLING MACHINE.

The spindle is of steel, with tapered front bearing running in a solid composition box, wear being taken up by facing off a cap which screws on over the end of the spindle, this facing forcing the spindle back into the bearing, where it is held solidly. It is driven by a cone for a 3" belt and is back-geared 5½ to 1, the largest step of the cone being 11½". The arbor is supported in a hardened and ground split bearing in the overhanging arm, which passes through a sleeve connecting the uprights and admits of a cutter 14" diameter being used if desired.

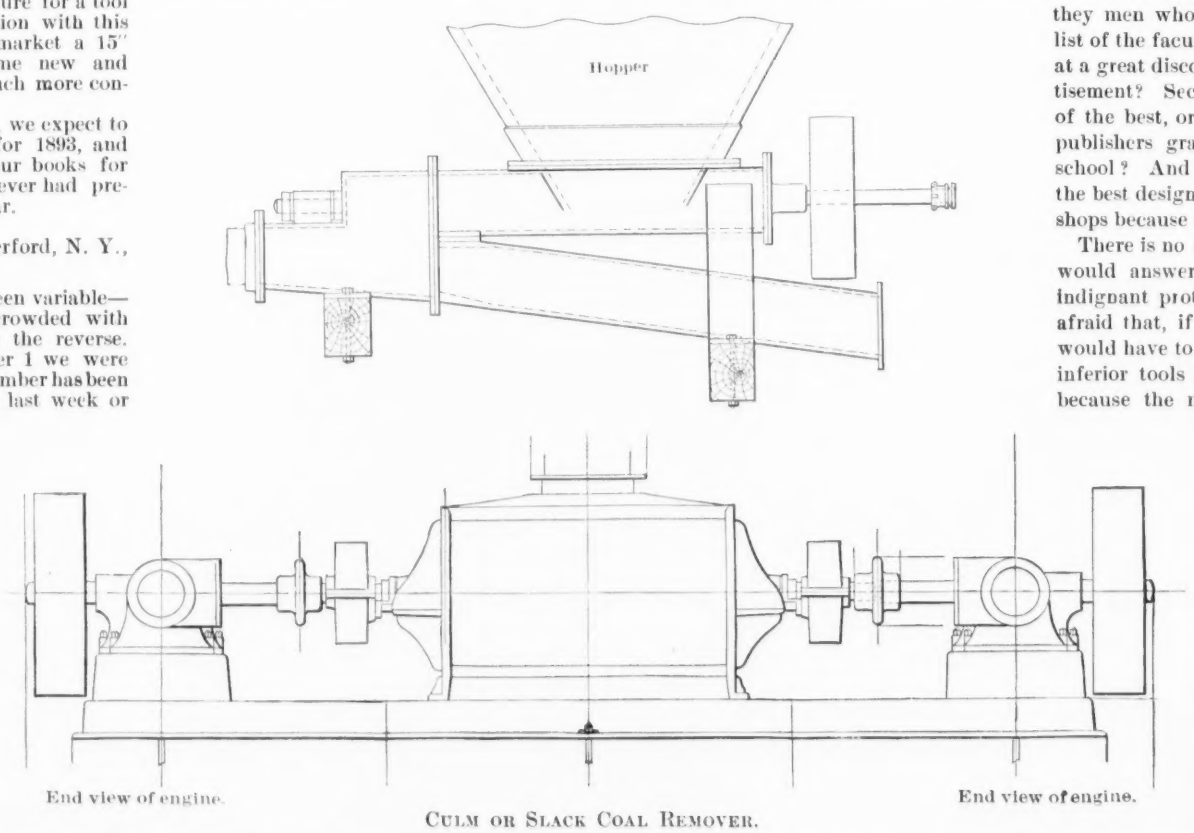
The table is 12" wide, 36" long, has three T-slots, and is fed the entire length by a large bronze screw running in oil, and engaging with a rack or section of a nut which is formed on the under side of the platen its entire length.

The upper feed cone is driven through the medium of spur gears, as shown, which are so arranged as to be readily changed to give any desired rate of feed, twelve changes being thus provided for; and, as the coarsest feeds are obtained by proportionately increasing the speed of the belt, its driving power is always ample. At the right of the knee is shown a squared shaft which furnishes the quick return for the platen.

The platen has a vertical movement of 19½", its highest position being with the top of the platen even with the center line of the spindle. The movement of the platen in line with the spindle is 6", and both these movements are measured by micrometer graduations. A newly designed vise is furnished, which is 6" wide and opens to 5¾". All wrenches and cranks are drop-forged steel, and finished. The weight of the machine is 2,000 pounds. Its manufacturers are the Garvin Machine Co., Laight and Canal streets, New York City.

Culm or Slack Coal Remover.

We present two outline engravings showing the arrangement of a plant designed for removing slack coal at coal mines. It consists essentially of a Root rotary blower driven direct (usually by two engines, as shown in cut), and what is known as the "Johnston feed arrangement," shown in the smaller engraving. For some time coal mine operators had been buying and using Root blowers for handling slack coal, the method being to feed the slack into the blast pipe beyond the blower, so that it does not pass through the blower, but is carried along through the pipes by the blast of air coming from it. Upon investigation by the Root Company it was found that the weak point in these devices was invariably the feed arrangement, and Mr. Johnson's feed was designed to overcome this. The slack is taken direct from the revolving screen into the hopper shown, and is fed along to the left by a screw, at the end of which it falls into the blast pipe, and is carried to its destination.



CULM OR SLACK COAL REMOVER.

It has been found by experience that this device does the work at a great saving, and deposits the slack in better shape, *i. e.*, it piles it higher, which is important where space is valuable. It is also found in practice that there is surprisingly little wear on the pipes used for conveying the culm or slack, the supposition being that it is surrounded by a film of air, and scarcely touches the pipe in passing through it. Plants for doing this work are designed specially for any given conditions by the P. H. & E. M. Roots Co., Connersville, Ind.

LETTERS FROM PRACTICAL MEN.

Machine Tools in Schools of Technology.

Editor American Machinist:

Manufacturing concerns are often called upon to donate machinery and tools to various schools and institutes of technology, and when they reply that it is impossible for them to comply with the request, for doing it to one they should do it to all, they are told that it is an excellent advertisement and one that the manufacturing concern ought not to let pass.

It is an excellent advertisement to have tools in schools, provided they are so placed on their merits; but when they are placed because some one underbids on a tool of the same character, and there is no competition as to excellency of design nor quality of workmanship—in fact, when there is no consideration of, much less competition on these points, the advertising argument falls away in the long run.

A question naturally presenting itself to a father seeking a school to which he can send his son is, "Is the school first-class in all respects?" If the father is a practical, well-informed man there are three points that he will consider: First, are the professors able men and authorities in their subjects, or are they men who fill the positions to swell the list of the faculty with their names and work at a great discount, for the sake of an advertisement? Secondly, are the text-books used of the best, or are they books on which the publishers grant large commissions to the school? And thirdly, are the machines of the best design and make, or are they in the shops because they are cheap?

There is no school in the country but that would answer the first two questions with indignant protest; but as to the third, I am afraid that, if the truth were to be told, it would have to be admitted that in many cases inferior tools had been placed in the shops because the makers offered them at a low price.

For what purpose was this discount offered? Was it because the makers had the interests of the school at heart, or was it because they saw future sales as a result of that one liberal discount?

I would like to ask in this connection whether the school is advertising itself by such a course, or whether it is acting as an advertising agent for concerns whose tools are in the shops for the single merit of cheapness. Would it not be for the best interests of the school to state that all of the machines are made by well-known makers, giving the names of such makers, rather than to ignore the fact in its circulars, or to state that they were made by concerns who produce tools that are acknowledged to be of a cheaper grade, suitable for some classes of work, but not for instruction in schools of the first class?

In after years, when the men have left the schools that have pursued a cheap policy, there is danger of their being led into errors that will not be creditable to the school that trained them. There are chances of

their being called upon to place tools in the shops over which they are given charge, and after a trial of a few months their employers may find that such tools are not of the best, and when such mistakes have been made, confidence in this and other points gained in school is likely to be shaken, for the durability of a machine is patent to any employer, while technical points are often accepted on trust, and if a man makes mistakes in matters that can be seen and judged of, why will he not make mistakes in matters concerning which most people are able to judge only by long observation?

There is probably no concern of any reputation but that would be willing to place its tools in competition with other makes and allow the professors, who have been appointed as the best men in their subjects, to be the judges. Such a course would certainly bring up the standard of machine tools in some of our schools.

I believe that the professors and instructors are always anxious for the best that can be had, but they find themselves handicapped by the mistaken policy of trustees and others who may have the ordering of the tools, and who believe that a lathe is a lathe as long as the spindle will turn around. The question of how it will turn, whether round or oval, does not enter into their consideration.

It is to be hoped that the time is not far distant when we can see our schools equipped with tools on the same principles that are followed by the best business firms.

A. D. B.

An English Foundry Foreman's Views.

Editor American Machinist:

Pardon me for taking this liberty of writing to you, as a reader of your paper. I saw a paragraph: "An Important Time with a Foreman and a Workman — Prudence and Crotchets." As a foreman iron molder of several years' standing, I can scarcely imagine how a foreman who has or holds such an important office should treat a new man in such a way as described. A foreman that has his eye on his master's business would never let a strange hand wait one hour before he gets a job. Fancy the feelings of the poor fellow. No doubt a complete stranger, he would feel it very keenly. I quite agree with Gascon it is nothing but right that a foreman should have the work laid out for a new man. Time is money. How can a man show his ability when he has no encouragement given him? The foreman's treatment would throw cold water on him instead of taking the man by the hand, as it were, and give him a few kind words and show him a little Christian treatment that will help a man to do a good day's work. As to a molder's ability and respectability of character he must have a fair trial. A foreman molder should have full control of the workman. He must give the right jobs to the right men. All men are not practical workmen. There are plenty of good, honest, hard-working men, that do their very best, that could not do all classes of work. I pay a man according to his worth, and draw a line as near as possible. As a foreman molder I have found the best way of dealing with a workman is to be kind, pleasant, civil; on the other hand, to give him to understand I want a fair day's work for a fair day's pay. If he should prove to be rather slow in his movements, to work about half an hour with him and push him on. That will soon show him that his job can be done in much less time. Should he turn round on me and be rather stubborn, then he will have to move on. I have several workmen under my control. I scarcely hear any bad language. I try and do fair and just to man and master. I get a fair share of work — quality and quantity. T. W. WILLIAMS.

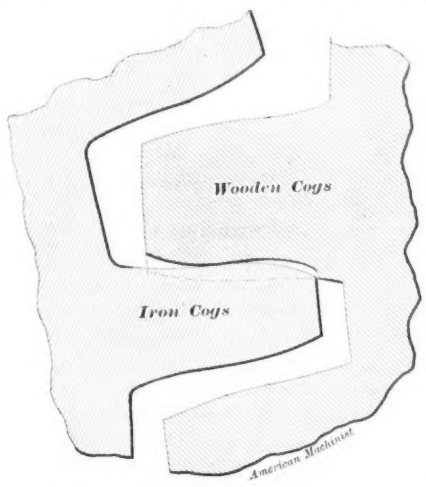
Why Are Gears Noisy?

Editor American Machinist:

Gears are theoretically noisy for more reasons than I could explain on six pages of this paper, but when reduced to a single practical explanation the trouble is about always that the gears are badly made, or worn out.

In the single case which I illustrate by the figure, I was called in to explain why a pair of heavy pump gears made such a racket. The pump ought to deliver three million gallons per day, but when forced above two millions the gears threatened to smash the whole business.

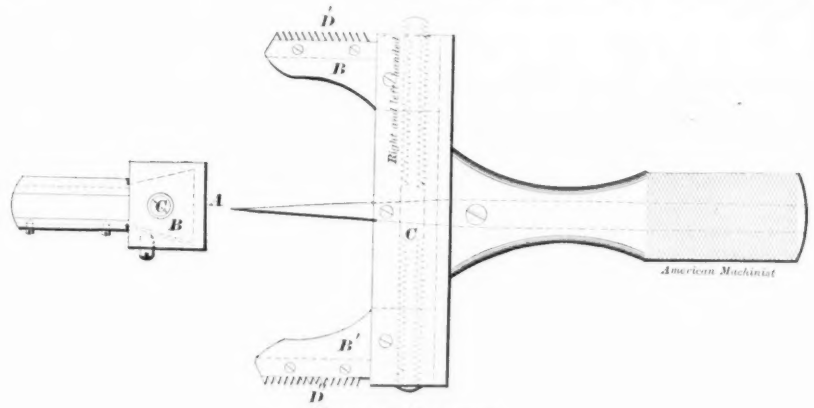
At the first glance it was plain that the gears were pretty nearly worn out. The hard iron pinion teeth had been digging their way into the soft wooden gear teeth



until the result was as in the figure—the wood worn away about a quarter of an inch, and the iron as good as ever.

My first observation was that the case was a good example of the very popular and silly notion that gear teeth tend to wear to the best shape. This idea is a good excuse for any botch of a millwright who can use it to pass any sort of a tooth that he can whittle out, with the remark, "It will soon wear right." These wooden teeth had worn into anything but a correct shape.

But the gears were evidently heavy enough for the service, as far as pitch was concerned, and therefore the query, Why did they wear so badly?



THREAD CALIPERS.

The reply was hard to get at, but finally came out. I found by calculation on the actual pitch diameters that the pinion had one too many teeth, so that its circular pitch was too small by about a sixteenth of an inch. There is no requirement in the theory of gear teeth so strict as the rule that two gears in mesh must be of the same circular pitch, and this case was far from satisfying that rule.

The verdict in this case was that the gears were noisy because they were a botch.

There is plenty of room for endless mathematics upon this question, and hairs can be split up fine as to whether the teeth should be of one shape or another, but the bottom fact is that if gear teeth are drawn by some one who understands how to draw them, and who is not addicted to some handy short cut of a rule for drawing the curves, but is willing to draw them out properly by the use of a good odontograph, and if the work is accurately done as drawn, the gears will not be noisy until they are worn or broken out of shape; and that, too, whether they are of one shape or another, short or long, epicycloidal or involute, straight or spiral.

Lexington, Mass. GEO. B. GRANT.

Thread Calipers.

Editor American Machinist:

As I was passing through a machine shop I saw a device for calipering the inside of threads, and as it seemed to me to be a good idea, I send a sketch of it. The following is a brief description. The chucks *B B* are adjusted by the screw *c*, which is held by the stock *a*, ribbed where needed for strength. Cutters may be inserted instead of pieces *D*, so that the device may be used for cutting washers. If you like, you may give this to your readers. A. W.

Development of the Micrometer Caliper.

Editor American Machinist:

I was interested in the article on micrometer caliper, and so send you the following:

In the year 1861, while I was working under instructions at the shop of W. R. Clapp, of Northampton, Mass., an old Scotch machinist came there to work, who had many tools that to us boys were new and novel. Amongst them was what he called a self-registering caliper. It was made of brass, and was identical with the modern micrometer caliper of to day, even to the adjusting screw in the end. This tool was made in France, and was graduated in the metric system. The writer, along with another shopmate, Truman Rose by name, started to make one each, but I failed to finish mine. Would like to hear from Rose, if he is in the land of the living. Perhaps he finished his and has it yet. JOHN J. GRANT.

The Link Affecting Point of Cut-off.

Editor American Machinist:

William S. Auchincloss, in his book on link motion, says in designing a link motion valve gear for marine engines it is necessary to sacrifice the equality of the cut-offs to the reduction of the slip of the link.

I have paid particular attention to the length of the connecting rods of some modern marine engines, and find that the greater portion of them are short compared to the length of the crank to which they are connected.

This would cause great inequality of crank angles for the half-stroke position of the piston, and with no slip to the link it would be an absolute impossibility to obtain an equal cut-off at half-stroke or intermediate points of the stroke between half-stroke and maximum cut-off.

I have been informed that while running the engines of the great Inman liner "City of Paris," under ordinary conditions, the engineers will set the cut-off for the high-pressure cylinder at five-eighths stroke.

The inequality of the crank angles for the down stroke ⅝ position of the piston and the up stroke ⅝ position of the piston attains a value of several degrees in the case of the engines of the "City of Paris," and if the link did not slip in the link die the cut-off would be hastened in the up stroke of the engine because the eccentrics, while the piston moves from the lower center to the ⅝ position of the up stroke, travel a greater number of degrees than they do as the piston moves from the upper center to the ⅝ position of the down stroke.

A shorter cut-off in the up stroke of such ponderous machines as the engines of the "City of Paris" would not be desirable at all when the weight of the connecting rod, piston and crosshead are taken into consideration.

I once shipped as oiler on a steamer somewhat smaller than the "City of Paris," just to satisfy my curiosity; if everybody else had their curiosity satisfied as I did there would be no one to run marine engines to day.

I shall not describe my experience here, but will return to the subject of my letter.

The valve of the high-pressure cylinder was driven by the Joy valve gear, while the valves of the intermediate and low pressure cylinders were worked by link motion; the links were double bar links, with the eccentric rods attached on the radius line of the link; the drag bars were also attached to the link on the radius arc of the link, but the tumbling shaft and arm to which the drag was connected were at such a height as to cause an equal cut-off by the link slipping in the link die. This I saw to my entire satisfaction while giving the links a dose of grease, and you and all others must confess that seeing is believing.

HARRY CORNELL.

Sensitiveness of Touch.

Editor American Machinist:

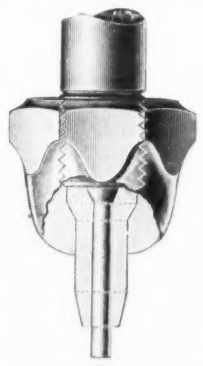
I have been greatly interested in the article entitled, "Sensitiveness of Touch," in your issue for December 22. Another illustration of a somewhat similar character may be of interest. Your readers are doubtless acquainted with the comparing caliper of the Syracuse Twist Drill Co. (if not, they should be). This instrument is constructed on the general plan of a beam compass. The fixed head carries a multiplying lever connected to the contact point. The end of the lever moves over a graduated scale reading to thousandths. Now it is perfectly easy to place the thumb against the contact piece, and produce movements of a single thousandth, which I think is a good deal smaller than would be expected. F. A. HALSEY.

Trial of the Monterey.

It is reported that an official trial trip of the new coast-defense vessel Monterey has just been made in the bay of San Francisco, Cal., and that the trip was very satisfactory to the contractors and naval engineers. Approximate computation seems to show that 5,452 horse-power was developed by the main engine alone. The maximum number of revolutions of the engine made during a four hours' run under forced draught was 168 per minute, and the average about 162. No great effort was made to ascertain the speed, as there is no speed requirement in the contract; but casual observations seem to indicate that the average speed was over 14½ knots. Great interest was manifested in the performance of the Ward coil boilers placed in the Monterey. These are said to have given very gratifying results.

Punch Bushing.

We illustrate herewith a form of bushing for small punches, which is made by Watson & Stillman, 204–210 East 43d street, New York. The bushing is held by the cap nut, as shown, and the manner of securing the punch will be readily understood. This is made from a piece of polished drill rod, which is simply cut off the proper length, and upset with a hammer to form the head. This method avoids the use of set-screws, supports the punch thoroughly, and is found to work well in every particular. The coupling in which the bushing is placed is one of the regular stock made by the same concern, and is adapted to hold standard punches of larger sizes without bushing.



A correspondent sends us a steel oil can in which he wishes to *hard solder* the bottom without destroying the spring temper of the bottom. The bottom is about three inches in diameter. Perhaps some of our readers may have had such experience in this kind of work as will enable them to suggest a simple way for arriving at the desired end.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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Machinery in Technical Schools.

On another page of this issue we publish a letter from a man who has evidently had some experience in the matter of equipment of machine shops connected with technical schools, and he places his finger on a feature of the business which has undoubtedly grown to be an abuse that needs reforming.

Most of the technical schools of the country are cramped for funds, and in many cases those who have the choosing of equipment for them feel obliged to reduce its cost to the lowest possible limit; often, as we know, against their own judgment as to what really should be done if it were possible. And in such a case the question of discounts naturally becomes an important one.

While it is a good advertisement to have one's tools in use in a technical school, it is also a good advertisement to have them in use in a machine shop where good work is done and where the selection has been made by practical mechanics looking for the tools that will best enable them to earn money and to build up or maintain a reputation; and, though "comparisons are odious," yet, if we were compelled to make a comparison between the quality of the two advertisements, we should unhesitatingly choose the latter.

Often the purchase of inferior tools is justified on the ground that they are good enough for boys to spoil, and there is some force in the argument; but such tools are more often put in because the leading makers have plenty of orders, are flooded with propositions to put in tools free of cost, or at heavy discounts, and cannot afford to take all the business of that kind offered. To the extent that these and other points referred to by our correspondent become understood by those interested in tools and in technical schools, the value of the advertisement coming from having one's tools in a school will disappear, and there is no doubt whatever that some schools have been injured in reputation by selections of tools and machinery that do not commend themselves to the judgment of practical men.

The Rapid Transit Muddle.

It will be remembered that some time ago we had something to say regarding the obvious advantages possessed by the Greathead system of deep tunneling for underground railroads for New York City. Chief among these we thought were the facts that such a tunnel could be worked in sections of such short lengths as to make its construction very rapid, and that it could be put through without interruption to the use of the streets and without interfering in any way with property rights, or causing any necessity for paying damages to property owners. The Rapid Transit Commission, however, seem to have paid very little attention to the Greathead system, and recommended a system of roads which involved much more expense, and which, as the test has shown, is not attractive to investors; at least, not under the conditions with which the franchise was offered at auction.

The drift of things now seems to be in the direction of giving the elevated roads more facilities, and it is freely charged as true what many predicted would be the case, *i. e.*, that the commission has taken such action as will, in the end, work to the advantage of the capitalists who own the elevated roads. At least it now seems probable that there will be a strenuous effort to secure for the elevated roads permission to use a greater share of the streets than they are now using, and, if so, the increased carrying capacity gained will be sufficient to so lessen the business of hanging onto looped straps while riding up and down town that the clamor for increased intramural traveling facilities will be for a time quieted.

There is little doubt but that the carrying capacity of the elvated roads would be very much increased by running the trains continuously around the lower point of the island at Battery Park, instead of stopping all trains there and then running them in the opposite direction; while such an arrangement would be a great convenience to the public, independent of the increased carrying capacity. No practical man will for a moment admit that any alleged difficulties in the way of doing this cannot be easily overcome, and the only apparent reason for not doing it is that the management of the roads seems to desire to bring about all the crowding and inconvenience possible, and then stand stubbornly in the way of any improvement which does not involve the giving by the city to the roads more of its valuable ground.

Ex-Mayor Hewitt, who has been one of the most prominent advocates of real rapid transit for the city, has now concluded that it is proper to give the elevated roads further control of the situation by allowing them space for additional tracks, but thinks that the concession should be accompanied by provision for ultimate ownership by the city, to be leased to an operating company. What will come of it all, no one can at present predict.

The Accident to the "Umbria."

On a recent voyage from Queenstown to New York the great transatlantic liner, the "Umbria," was completely disabled by the breaking of her shaft.

There is nothing particularly remarkable about this. Such things have frequently occurred, and it may be assumed will always occur, but there are some things in this that are worthy of note. One of them is that, while many people on this side of the water had friends on that ship, there was but little alarm felt for their safety. It is understood that accidents may happen that will delay one of these great steamships, but it is quite as well understood that the construction of these ships is such that an accident which, a few years ago, would have caused the sinking of any steamship afloat, is to-day of little consequence, and at the present time something quite remarkable in the way of an accident is necessary to sink one of them. Made up as they are of water tight compartments, it is certain that an accident can happen to one part of them, and still the vessel remain afloat. Then, as they are constructed to contend with the waves and the seas, they will go on, probably delaying their arrival, but there is little fear of their going to the bottom.

People who now travel on modern steamships are inclined to feel a little safer than they are when on shore.

There is another thing worthy of consideration. The main shaft of the "Umbria," as we have it in our mind, was 24 inches in diameter. Now it seems an enormous pressure of steam must be required to twist such a shaft as this off. It looks immense to us who spend our time on shore, but it is well known to steamship engineers that they will be twisted off. In fact, it is considered from the time of construction up that it is only a question of time when they will fail. First, the shaft must be kept within moderate limits as to diameter, in order to reduce the friction to as low a limit as is practicable. This means that such a shaft is generally made smaller than the strictest mechanical constructions would call for. It is probably proper that it should be so made. Then again, if we take the conditions under which such a ship is worked, we shall find further reasons for its failure. It is impossible that such a shaft shall be kept strictly in line. Now if we take a piece of iron—it matters not to what use it may be put—and continually bend that piece, it is only a question of time when we shall break it. This is the condition under which the main shaft of a modern steamship constantly works. As we have said before, it is never in line. It is constantly being bent this way and that way, and as surely as can be will finally fail. There is no help for this, so far as we can see. We must take the conditions as we find them, and must meet them in the best way possible to meet them, and that is exactly what is done in the construction of the modern steamship.

Let us recapitulate. We must not make the shaft too large, or we induce undue friction, which prevents speed. We cannot put the shaft actually in line, and finally it will break, whatever its size might be. But modern science and the exercise of modern skill have done so much for us that all we expect in the event of a failure of the shaft of a steamship is some delay. We know as nearly as we can know anything, we shall keep top of the waves, and come to shore a little later, perhaps, but come there safely and properly.

It might be said that the shafts of steamships should be made so large that they would not break, but then we sacrifice speed—we put power to useless purpose, and on the whole it is wise, perhaps, to take the risk which will come of a breakdown of this sort, rather than sacrifice the convenience and comfort secured by the speed which we get in modern steamship transportation.

It ought to be stated that the engineer corps of the "Umbria" experienced no serious difficulty in putting the vessel in shape to complete her voyage.

In mechanical matters, as in everything else, there are curiosities. This has just occurred to us in noting the fact—and such instances are common, but this one comes up to us particularly—of an American engineer who has gone to England, and is there doing remarkably well.

Now right with this we find a friend of his—an English engineer—who has recently come to this country, and is also doing remarkably well.

The reason for this is not quite so apparent. Still, if we looked into the thing as deeply as we ought to do, we should probably find that each of these men had something about him that peculiarly fitted him for the place to which he went. After all this is a good thing, but it shows that a man is cosmopolitan; that he is not tied up to any locality, but can use the knowledge which he has gained wherever it comes in to the best purpose. We are always glad to see our English friends come here and do well. We are always glad to note that our American friends go to England or France, or wherever it may be, and do well. After all, isn't that exactly the right way to look at the matter?

We have received the following from the Secretary of the institution named:

"In the educational department of the Young Men's Institute of the Young Men's Christian Association of the City of New York, 222 and 224 Bowery, much attention is being given to technical studies, and the work is becoming more and more valuable to young mechanics and artisans. The evening classes in Electricity, Steam Engineering, Carriage Drafting, Mechanical Drawing, Free-hand Drawing, Shorthand and Typewriting, Vocal Music, Arithmetic, Bookkeeping and English Grammar have an enrollment of almost three hundred young men. [A free exhibition of work done in the classes was given on December 26th.]

"The Institute Committee of Management and the Carriage Builders' National Association award prizes, diplomas, and certificates of progress at the close of the year."

Literary Notes.

TIPS TO INVENTORS: Telling what Inventions are needed, and how to perfect and develop new Ideas in any lines. By Robert Grimshaw, Ph. D., M. E., author of "Steam Engine Catechism," "Pump Catechism," "Boiler Catechism," etc.

In this little volume the author aims to render the inventors a twofold service, first, to point out unprofitable fields, and second to point out lines in which inventions are needed; the latter embrace hints in the electrical field, chemical, metallurgical, stationary and marine engineering lines, common roads, textile, heating and lighting, writing and printing, and miscellaneous subjects. The majority of hints are good and valuable to the inventor, and a few of the hints, if followed, will result in a waste of time; jet propulsion of vessels is one of them.

A chapter is devoted to advice relating to perfecting and developing inventions, and which all inventors can read with profit, although there is one expression which may lead to a misunderstanding; it is this:

"Whenever you have anything to show to anybody else, anything to sell, see that you have a good sample or a good bait." Now, no doubt, the author means to be perfectly honest, but we believe that the word "bait" is not well chosen, as it may be taken to mean a good sample of a worthless article got up for the purpose of deceiving; such practice is, of course, dishonest, and cannot be too severely condemned.

The tables of populations of different countries and cities are useful. On the whole, the book will be of service to all who make inventing a profession. The book is published by the Practical Publishing Company, 21 Park Row, New York. Price, $1.

We are indebted to the publishers of *Locomotive Engineering* for a fine bound volume of that journal for 1892. It forms a valuable record of progress in railroading during the year, and contains much that is of great interest regarding railroad matters in Europe, and within the Confederate lines during our civil war.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(21) W. W, Norristown, Pa, writes: Please give me a description of the shaft on steamship "Umbria." Was it made of cast-steel or iron? I have looked through your paper for an account of it but did not find it. I have read of it in the daily papers, but would rather have your opinion. *A.*—The shaft is made of steel; its exact diameter we have not been able to ascertain; it is about 25 inches.

(22) W. S J., Portsmouth, Va., writes: Please favor me with a description of double-ported slide valve, also piston valve in use on triple-expansion engines of present date. I have seen both, but did not have an opportunity to examine closely. This information would be of great service to me at present. *A.*—You will find an illustration of these, and the cylinders also, in our issue of November 24, 1888.

(23) H. R., Alliance, O., writes: We have one horizontal shaft and another inclined at 45 degrees to the horizontal plane. At what angle should the latter shaft be placed so as to make the belt run without guide pulleys? *A.*—If we understand your question correctly, the angle of the shaft is already given, and therefore all that remains to be done is to select the proper diameters of pulleys and place them on the shafts as explained in answer to Question 241 in our issue of June 2, 1892.

(24) H. P. N., Brockton, Mass., writes: Kindly answer the following questions through your columns: 1 What number of thousandths of an inch correspond to the sizes of machine screw taps? Please give the equivalent of each size. *A*—You will find tables of the number and diameter of machine screws given in our issue of August 18, 1888. 2. Do these numbers conform to the standard screw gauge given on page 234 of Brown & Sharpe's catalogue of 1892? *A.*—Yes.

(25) C. H., Winchester, Ill., writes: I wish you would answer the following questions: What are the correct definitions of a high-pressure and a low pressure engine, condensing and non-condensing engines? Please answer these questions very plainly. *A.*—The terms high and low pressure engines in the present advanced state of steam engineering have no meaning, and consequently are not, or should not be used. In former times, when low steam pressure was used, the term high-pressure engine was applied to engines which we now call non-condensing engines; and the term low-pressure engine was used instead of condensing engine. A non condensing is one in which the exhaust steam is allowed to escape directly into the atmosphere; and a condensing engine is one in which the exhaust steam flows into a condenser.

(26) S. B. B., Detroit, Mich., writes: I would like your opinion in regard to a pair of cast-iron bevel wheels that are running in our shop. 1. They make a great noise; how could I deaden the sound? *A.*—The noise may be due to various causes. For instance, the shafts may not be in alignment; or the teeth may have an incorrect form. These causes will suggest the remedy. We prefer to remove the cause, and not attempt to hide it by deadening the sound, as noisy gears indicate a defect somewhere, which generally has an injurious effect on the building, or on the machinery connected to the gears. 2. We have these gears running in a box. The grease we use on them runs out through the hole through which the shaft passes. What could I use around the shaft to prevent the grease from running out? *A.*—This may be prevented by a stuffing box packed with hemp packing. 3. Which is the best kind of grease to use? *A.*—We should simply use good hard tallow, in very moderate quantities.

(27) W. D. T., Pittsfield, Ill., writes: Inclosed you will find a sketch of the relative position of a vertical deep well pump and the water tower. The pump is a new one, and replaces a crank and belt pump. The artesian well is 1,228 feet deep. The old pump used to deliver into the tank 1 foot of water per hour, the new one delivers water at the rate of 6 inches per hour, and when the new pump throws water into the street through hydrants it delivers 9,260 gallons per hour, which is equal to 9 inches in the tank. The water is a mineral water, and is full of gas. The pipes are connected to the pump in a manner so as to leave a short length to act as an air chamber. Now I claim that it does not require an air chamber; in fact, I believe that the collection of gas in the air chamber is detrimental to the pump; the belt pump had no air chamber and worked well. Please give me your opinion on the subject. *A.*—The air chamber should not decrease the quantity of water delivered in a given time. If we understand your sketch correctly, we should say the reason for delivering more water through the hydrant than into the tank lies in the fact that, in delivering into the tank, the water is forced against a head, and in delivering the water through the hydrant this head tends to increase the quantity of water delivered. We have, however, not sufficient data to express a correct opinion. We should advise you to consult the manufacturer of the pump; he will undoubtedly be able to locate the trouble, if any, after a careful examination of the conditions under which the pump has to work; or engage the services of an engineer who is familiar with this class of work.

(28) L. H. W., Rutland, Vt., writes: I saw in your December issue, Question 542, an inquiry relating to boiler heaters and their saving of fuel, and I note your answer. Will you please examine the inclosed circular and see if it is not worthy of a modification of the answer referred to? Also give your opinion of the statements relating to the benefits derived from these heaters, bearing in mind the intense heat obtained by their use. *A.*—The boilers mentioned in Question 542 are marine boilers, and your heater cannot be applied to them. Your circular shows that the heaters are simply rectangular boxes, or water backs made of steel and set in the brickwork around the grate and connected at the top by pipes to the boiler, which is shown to be a cylindrical tubular boiler, the feed water entering at the bottom of the water backs. Attaching the heater, which you call a superficial heater, in the manner shown, converts the boiler practically into a locomotive boiler, and all the benefit you can obtain is to save the heat wasted by radiation of the brickwork of an ordinary well-constructed and well-set stationary boiler; in short, you cannot gain any greater advantage than can be gained by the use of a locomotive boiler. When the water is comparatively pure the feed water may be entered at the bottom of the water backs, although there is the objection of cold water striking the highly heated sheets; but if the water is very impure we should hesitate to do so, because the water backs are liable to fill rapidly with mud, unless the fireman takes exceedingly great care to keep them clean. If the mud is allowed to collect in them to any great extent there is danger of burning the inside sheets. The feed water is very seldom allowed to enter at the bottom of the water leg of a locomotive boiler; it usually enters at the smoke box end, as this is the coldest part, and is not liable to injure the highly heated sheets by the impingement of cold water.

(29) J. H J., Harvey, Ill., writes: I come to you again for information on a subject which I do not understand, and that is to calculate the change of gear wheels necessary to cut a given pitch of thread in a compound lathe. I can figure them out in a single-geared lathe all right, but when it comes to a compound I am stuck. Now will you please explain and give me a simple rule? *A.*—This is a question that has been frequently asked. It was answered in our columns about two years ago, but since the subject is an important one to many mechanics, we reprint the rules; these will cover any case. If the lathe is simple-geared, and the stud runs at the same speed as the spindle, then select some gear for the screw, and multiply its number of teeth by the number of threads per inch in the lead screw, and divide this result by the number of threads per inch which you wish to cut. This will give you the number of teeth in the gear for the stud. If this result is a fractional number, or a number which is not among the gears which you possess, then try some other gear for the screw; but if you prefer to select the gear for the stud first, then multiply its number of teeth by the number of threads per inch which you wish to cut, and divide by the number of threads per inch on the lead screw. This will give you the number of teeth for the gear on the screw. If the lathe is compound, select at random all the driving gears, multiply the numbers of their teeth together, and this product by the number of threads you wish to cut. Then select at random all the driven gears except one; multiply the numbers of their teeth together, and this product by the number of threads per inch in the lead screw. Now divide the first result by the second, and you will have the number of teeth in the remaining driven gear; but if you prefer, you can select at random all the driven gears. Multiply the numbers of their teeth together, and this product by the number of threads per inch in the lead screw. Then select at random all the driving gears except one. Multiply the numbers of their teeth together, and this result by the number of threads per inch of the screw you wish to cut Divide the first result by the last and you will have the number of teeth in the remaining driver. When the gears on the compounding stud are fast together, and cannot be changed, then the driven one has usually twice as many teeth as the other, or driver, in which case you can, in the calculations, consider the lead screw to have twice as many threads per inch as it actually has, and then ignore the compounding entirely. Some lathes are so constructed that the stud on which the first driver is placed revolves only half as fast as the spindle. You can ignore this in the calculations by doubling the number of threads of the lead screw. If both the last conditions are present, you can ignore them in the calculations by multiplying the number of threads per inch in the lead screw by four. If the thread to be cut is a fractional one, or if the pitch of the lead screw is fractional, or if both are fractional, then reduce the fractions to a common denominator, and use the numerators of these fractions as if they equaled the pitch of the screw to be cut, and of the lead screw respectively. Then use that part of the rule given above which applies to the lathe in question. For instance, suppose it is desired to cut a thread of $\frac{25}{32}$-inch pitch, and the lead screw has 4 threads per inch. Then the pitch of the lead screw will be $\frac{1}{4}$ inch, which is equal to $\frac{8}{32}$ inch. We now have two fractions, $\frac{25}{32}$ and $\frac{8}{32}$, and the two screws will be in the proportion of 25 to 8, and the gears can be figured by the above rule, assuming the number of threads to be cut to be 8 per inch, and those on the lead screw to be 25 per inch. But this latter number may be further modified by conditions named above, such as a reduced speed of the stud, or fixed compound gears In the instance given, if the lead screw had been $2\frac{1}{2}$ threads per inch, then its pitch being $\frac{4}{10}$ inch, we have the fractions $\frac{4}{10}$ and $\frac{25}{32}$, which, reduced to a common denominator, are $\frac{64}{160}$ and $\frac{125}{160}$, and the gears will be the same as if the lead screw had 125 threads per inch, and the screw to be cut 64 threads per inch.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gear Advertisement is always on page 11.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

New lists of cutters. Brown & Sharpe.

Norway Rivets. Evans & Robertson, Cincinnati, O.

6 Spindle Turret Drills. A. O. Quint, Hartford, Ct.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments.
Gould & Eberhardt, Newark, N. J.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Standard Tool Co.'s Twist Drills.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Clayton Air Compressor Works, 43 Dey St., N. Y. Compressors for experim'ts to 300 lbs. pressure, $50.

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Most sensitive and durable Damper Regulator made; works within one pound. Send for circular. T. Kieley, 11 W. Thirteenth Street, New York.

For the Latest Improved Diamond Prospecting Drill, address the M. C Bullock Mfg Co., cor. Canal and Washington Sts., Chicago, Ill.

Combination Gear Cutters in stock. Vertical Miller, Drill and Slotter in one machine, worth its weight in gold. R. M. Clough Tolland, Conn.

Roper's Practical Handy-Books for Engineers & Firemen: Descriptive Catalogue mailed free. Edward Meeks Pub., 1012 Walnut St., Phila., Pa.

We electrotype illustrations and advertisements for manufacturers. Prompt and thorough service. Send for estimates. A. Mugford, Hartford, Conn.

Gear Cutters, Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Thirteen-inch Light Drill Press.

We illustrate herewith a light and sensitive drill press made by the George Burnham Company, of Worcester, Mass. The countershaft of this machine is bolted to the base, and the belt which runs from it to the spindle pulley cannot by any unevenness cause a jar or vibration in the machine, since the forces which ordinarily cause these are resisted within the machine itself. Independent bearings are provided for the driving pulley, which relieves the spindle of the belt pull, and this pulley is large enough to give ample power with the belt running quite loose. The spindle is of steel, and is bored No. 1 Morse taper. The quill has steel rack and pinion.

The table is raised or lowered by a screw which is double and the spiral pitch of which is 3 per inch, so that it can be moved rapidly and will stay where it is placed. A line is drawn upon the column and a pointer placed upon the table arm, which enable the center of the table to be brought exactly under the center of the spindle. The spindle is counterbalanced by a spring, the tension of which can be changed to suit circumstances. The bell and pointed center are provided for

center drilling and reaming. The machine is made with square table and base if preferred. The column is 4½″ diameter. The capacity of the machine is to drill a ⅝″ hole in the center of a 13″ circle 4½″ deep without moving the table; greatest distance of table from spindle, 36″. Table is 11¼″ diameter. Diameter of spindle pulley, 8″. The machine weighs 350 pounds.

A Review of Fly-wheel Formulæ—IV.

By Professor Joseph Torrey.

There is no need to dwell longer on the question of single-crank engines working against constant or fairly steady resistance. Many more modern authors might be cited and many formulæ recorded, but nothing material would be gained, considered simply as a problem in mechanics. The design of a fly-wheel for any purpose and to fit any circumstances is a simple matter. The question of strength is an important one and will be discussed farther on. We will next consider the case of two and three-crank engines.

Before going into the history of the subject we will, by way of reassuring ourselves, see that it depends on fundamental principles, as every such question does. For the present we will disregard all so-called "results of experience" and practical details. These have their place, but the object of these papers is not to furnish a manual of foundry practice or a treatise on strength of materials. Our purposes are quite different. The principal one at present is to show that the problem of designing a fly-wheel for a pair of engines coupled or for three such engines coupled brings in no new principles and no new methods. If it were thought best by a designer to work out his fly-wheel designs from a strictly mechanical standpoint, all that would be necessary would be a clear perception of the principles and reasoning which have been given up to this point. In some respects it is very unfortunate that particular applications of general principles are so often made and presented as if they needed especial methods of thought, and were not within the scope of simple reasoning.

Now let us take a look at our single-cylinder formula and see in general what must be done to it in order to fit it for coupled engines. The formula for rim weight is

$$W = \frac{c\,E\,g}{m\,V^2}.$$

Suppose, to simplify the case, that the engine is to be used for the same kind of duty and to run at the same speed as the single engine, then m, V and g will not need any change at all; the only variable factors then are E, the total rotative energy per revolution, and c, the excess of rotative energy over the average for one revolution. As regards E it will evidently be doubled, as we have doubled our power. The question then is solely as to the change the new conditions will make in the value of c. All this is, be it remembered, that we change no other conditions. All we do is to take two of our single engines, couple them to the same shaft with cranks at right angles, and run them at the same speed, thus giving us twice the power we had before. If we had, instead of making this arrangement, put a new cylinder on our single engine, which would double the power, keeping all the time the fly-wheel diameter the same as before, and not changing the speed in revolutions per minute, then E would be doubled, and our formula shows that the fly-wheel rim weight would have to be doubled also.

We will now proceed to examine the double engine and see if our coupling has made any difference in the regularity and uniformity with which rotative effort is applied to the crank-pin.

Fig. 1 represents a diagram from a single engine in which the curve $r\ r$ is the curve of rotative effect, the straight line $a\ a$ is the line of *average* rotative effect, $i\ i$ is the inertia curve, and $c\ c$ the curve of effort along the connecting rod on the crank-pin. This diagram was laid out as described in the American Machinist for July 9, 1891. It is not necessary to repeat the method here.

The average rotative energy per revolution is represented by twice the figure $a\ a\ o\ o$; that is, by the product of the average rotative pressure per revolution by twice the stroke, which is the distance through which the pressure acts. The small figure $r\ r\ n\ n$ represents the excess over the average rotative energy per stroke. Multiplied by 2, it gives the excess over the average per *revolution*. Dividing the small area by the large one (the areas being measured by planimeter

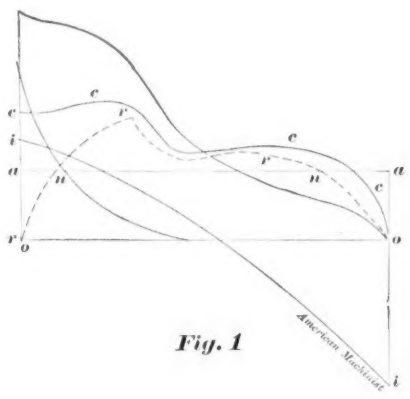

Fig. 1

or by dividing the diagram) gives, in case of the single engine, 0.217 as the value of the constant c.

Passing to the coupled engine, we must first construct the curve of rotative effect. To do this we need only remember, first, that, since the cranks are always 90° apart, any event in the crank travel of one engine will occur at points 90° from the corresponding event in the travel of the other; and second, that the rotative effect at any point in the stroke will be equal to the combined rotative effects of both engines at that point. Reference to Fig. 2 will make this clear.

$O\ A$ and $O\ B$ are the two cranks, $a\ c$ represents the piston stroke, the direction of rotation being as indicated by the arrow. The crank $A\ O$ is just beginning on the left-hand end of the diagram of rotative effect, as seen in Fig. 1. When $O\ B$ arrives at C, *and not till then*, it will also begin to make a similar diagram. In order that $O\ B$ may arrive at C the piston which drives $O\ B$ must travel the distance $n\ C$.

Let us, for the sake of convenience, suppose that the lower half of the circle $A\ C$ is turned in the plane of the paper on c as center. We shall then have our diagram arranged; the total piston travel for a revolution is represented by $A\ A$. Now starting at the point A we first draw in, according to scale, the diagram of rotative effect given by Fig. 1. Next we measure toward the right a distance $A\ x$ equal to $n\ C$.

This point n is the point where the crank $O\ B$ will *begin* its diagram corresponding to the one we have just laid out for $O\ A$; so at this point x we begin and draw in a second diagram of rotative effect. Now as a matter of fact this second diagram will not be exactly the same as the first one, because they are made at different ends of the cylinder; and since the piston speed varies differently at the two ends the diagrams from the two ends will not be quite alike. With connecting rods of six cranks length no serious error will result from simply repeating the first diagram. With shorter rods it is better to take the two separately and use them in their proper places. At all events the two diagrams will have the same general shape and will face the same way. We now have

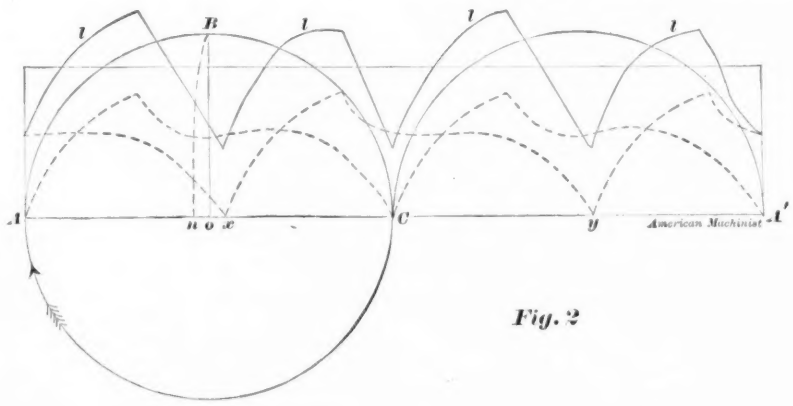

Fig. 2

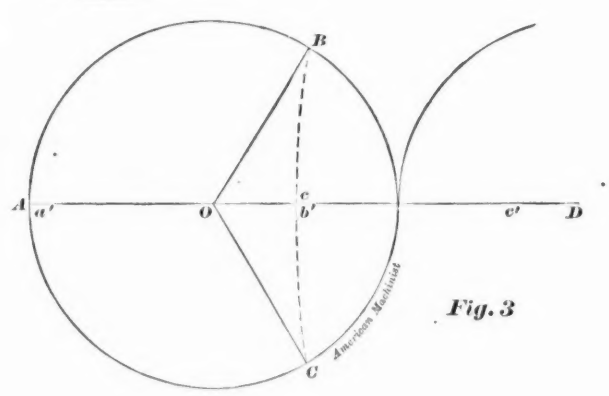

Fig. 3

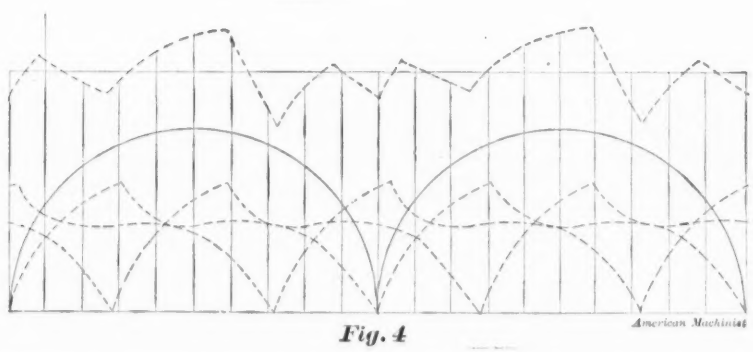

Fig. 4

the intervals fixed at which the two cranks will begin to make diagrams. Evidently as soon as either crank has finished one diagram it will begin another at the other end of the cylinder. If this is so then when the crank $O\ B$ began its diagram at x it must have just finished one. Also when it ends its work at y it must begin another at that point; the same is true of the crank $O\ A$. So what we must do is to make each of these two diagrams we have drawn, a part of a chain of similar diagrams. The best way to do this practically is as follows: First draw the rotative diagram on a piece of thin transparent paper or tracing cloth. If the diagrams from the two ends of the cylinder are to be used draw them on separate slips, labeling one "head end" and the other "crank end." Now in Fig. 2 the first diagram is a crank end one. It ends at C and the head end diagram begins; so take the slip having the head end diagram on it, lay it so that the base line coincides with $A\ A'$, and so that the left hand end of it comes just at C. Then with a sharp wooden point run over the tracing, thus transferring an impression of the diagram to the large figure. This can then be drawn in with pencil or pen, and the work is done so far as crank $O\ A$ is concerned.

Now let us pass to crank $O\ B$. Its diagram which it begins at x is a head one. It ends at y and a crank end one begins; so, beginning at y, trace in as before a crank end diagram, or so much of it as lies to the left of the perpendicular line at A'. Further, when the head end diagram began at x a crank end one must have just been completed; so we draw in so much of a crank end diagram ending at x as lies to the right of a perpendicular erected at A. We shall then have the completed figure, in which we can see the way the crank impulses of the two engines follow each other. We next proceed to plot from this a diagram which will represent the combined effect of these impulses at any point in the strokes.

Beginning at the left-hand end of Fig. 2 we see that the piston corresponding to crank $O\ A$ is exerting no rotative force whatever, and this, of course, must be so, because the crank-pin is on the line of centers. The piston corresponding to crank $O\ B$, however, is exerting rotative effect equal to $A\ k$. At any other point in the stroke the total rotative effect will be the sum of the rotative effects of the two engines at that point. Divide the line $A\ A'$ into twenty equal parts and draw perpendiculars through these division points. On each perpendicular lay off a height equal to the sum of the heights of the two rotative diagrams at that point in the stroke.

Until some little experience has been acquired in such work it is better to make the measurements a little closer together. For instance, the total rotative effect might well be found at points half way between the main ones. When this is done draw a line through the points thus obtained, and we have the line $m\ m$, which is the curve of rotative effect for one revolution.

This is now to serve as a basis for finding the value of c as follows: First determine the average height. This can be done either by the planimeter or by the ordinary measuring method as applied to indicator cards. Then draw a line parallel to the base line and at a height above it equal to the average height of the rotative curve. The part of the rotative diagram which lies above this line is the excess of rotative energy above the average for one revolution. Determine the area of this small portion above the average line. Also determine the area of the whole rotative diagram. Divide the former by the latter, and the decimal fraction resulting will be the value of c for our coupled engine. Looking once more at our diagram we see that coupling has changed its appearance very markedly from that of the single diagram in Fig. 1. There then were two points where the rotative force rose to a maximum; here there are four such points. That is, instead of two pushes on the crank per revolution we have four, and it is easily seen that the effect of this will be to make the motion steadier, and require less regulating power in the fly-wheel. The value of c as found will confirm this observation.

The only other case we will consider is that of three engines coupled with cranks at angles of 120° to each other. The construction will be carried out exactly as in the preceding case. The only part that need be described particularly is the very first step. Fig. 3 will illustrate this.

Draw the circle to the proper scale to represent piston stroke and crank travel. Then, having compasses set to the connecting rod length, strike arcs through the points A, B and C in the usual way, and mark on the line $A\ D$ the points $a\ b\ c$, which will give the piston positions at which the rotative diagrams will begin for the three cranks. The circle can then be opened out as in the other case, when a, b and c' will be the required points. The rest of the construction is exactly the same as for two cranks at right angles, and the general shape of the resulting diagram is shown in Fig. 4. Here the most casual glance shows that the value of c has been very greatly diminished; we now have

a much more uniform rotative effect, and the impulses are slight and distributed. This is only one side of the problem, but it is a very necessary one to see clearly, for it is the nearest side to foundation principles. In the next paper we will investigate the history of the matter and see what has been done on the subject in times past, and what is said by present writers. Finally we will see whether we can evolve from the accumulated matter any conclusions which will be of use.

MANUFACTURES

Marble and granite works are soon to be established in Rantoul, Ill.

The Westville Coal Co., of Danville, Ill., has incorporated; capital stock, $50,000.

A franchise has been asked of Pekin, Ill., for building an electric street railroad.

Mr. Baumgardner, of Hanover, Pa., is erecting machine shops at Chestertown, Md.

A canning factory, with a capital stock of $5,000, has been organized at Rossville, Ill.

The Pontiac (Ill.) Coal Company is going to add a brick and tile machinery to their present plant.

Dowagiac, N. Y., will have a new factory for the manufacture of railway specialties and supplies.

The Memphis & Charleston Railroad Co., office in Memphis, is building car shops in Sheffield, Ala.

The Rainbow Coal Co., of Cleveland, O., has recently been incorporated, with a $500 000 capital stock.

The Independent Biscuit and Cracker Company, of Pekin, Ill., are going to enlarge their works this winter.

The Litchfield (Ill.) Canning and Pickling Company has been incorporated, with a capital stock of $5,000.

The Brooks Arms and Tool Company has decided to locate its plant at Woodfords, Me., on land near the railroad.

James Jones, Los Angeles, Cal., has established himself in business for the manufacture of brass and iron goods.

The Boston Ventilating and Engineering Company, Springfield, Ill., have certified to an increase of capital stock from $500,000 to $1,000,000.

The Peerless Coal Co., of Centerville, Ia., has incorporated. Jas. E. Lee, Thos. E. Lee, David A. Lee and H. A. Russell as directors. Jas. E. Lee, president; H. A. Russell, secretary. Capital stock, $200,000.

The Buffalo Forge Co., Buffalo, N. Y., has issued an elegantly printed catalogue, setting forth and illustrating its products. The title of the company does not indicate its various lines of manufacture—the catalogue will do this.

Fred. A. Welles, Milwaukee, Wis., issues a circular illustrating various small tools he makes for the use of mechanics—particularly machinists. The price is given, so that a machinist can judge for himself as to his ability or inclination to buy.

The Baldwin Locomotive Works announce that from the beginning of this month Messrs. Robert Spencer and Carter H. Fitz Hugh will act as their representatives for the Northwest, with offices at 1013 Monadnock Building, 98 Jackson street, Chicago, Ill.

The Snow Steam Pump Works, of Buffalo, N. Y., is completing the new machine shop which it has been erecting adjoining its present works, and which it expects to occupy during the coming winter. The new shop will multiply the present capacity of the works five or six times.

The Worcester & Spencer Street Railroad Company, of Worcester, Mass., has filed a petition to the Legislature asking for authority to purchase and consolidate with other electric roads, to issue bonds, increase capital stock, and change its name to the Worcester Suburban Street Railway Company.

The recently incorporated Niagara Car Wheel Co., Buffalo, N. Y., has purchased property on which a building 700x300 feet will be erected, and the manufacture of cast-iron car wheels, castings and iron work will be carried on. Some foundry work is to be done, but the principal business is in wheels and castings.

The Fulton Iron Works, San Francisco, Cal., are preparing their new site on the water front at Harbor View, and will soon commence operations. Ever since the fire the proprietors have been anxious to get suitable shops. The new company will engage extensively in shipbuilding, and will have ample facilities for this class of work.

A new steam mill is to be erected on the Lowelltown (Me.) timber tract owned by I. H. Merrill, of Bangor, Me., by Mr. Hazen, a Vermont manufacturer. The location is a little over a mile from the Canadian Pacific Railway, which will run a spur track to the mill. Mr. Hazen expects to cut and manufacture about eight millions yearly.

The Nova Scotia Steel and Forge Company, New Glasgow, N. S., has just completed the erection of its new machine shop, 175x75 feet. It has just commenced the erection of a new rolling-mill plant, which will be continued in an iron building 250x75 feet. This company now employs 450 hands, which number will be increased when the new mill is completed.

The Litchfield Car and Machinery Company, Litchfield, Ill., is just completing new brick machine shops 205x55 feet, fitted with a 100 H. P. Corliss engine, a 7½ ton electric traveling crane. The new shops will have, besides other tools, 3 planers of various sizes, 1 slotting machine, 2 shapers, 8 lathes, 1 radial drill, 1 upright drill and 1 portable drill, and 1 special wheel boring machine.

The Robb Engineering Company, Amherst, N. S., is enlarging its works by the addition of a brick building, 90x100 feet, to be used as foundry and engine room. It now has a boiler and blacksmithing shop 50x150 feet, and a machine shop 40x135 feet, two stories; pattern room, drafting room and offices. This firm was established in 1848. It was burned out in 1890, and rebuilt at once. It employs ninety hands.

Advertisement is made of a petition to the next Legislature for an act incorporating the Watertown, Woodbury & Southbury Electric Railway Company. The plan is to commence the line at Hotchkissville, thence to Woodbury main street to Pomperaug Valley Station, to Southford Station; also from the Woodbury main street, through Minertown, to the railroad station in Watertown. The signers are Horace D. Curtis, Floyd F. Hitchcock, Arthur D. Warner, James Huntington.

In the recently completed large "annex" building of the Lozier Manufacturing Co.'s establishment at Toledo, O., a "house-warming" was held, at which the proprietor and leading men met the employes, their wives and sweethearts, for an evening's social enjoyment. There was music, dancing, feasting and speech-making, during which renewed pledges of friendship and good will were given. The company makes bicycles, and a feature of the evening was an exhibition of some of their new products in this line for 1893. The president of the company stated that no general was more dependent upon the loyal support of his soldiers than was the proprietor of a factory upon his workmen. He declared his intention to do what he could to preserve the good feeling now existing.

Machinists' Supplies and Iron.

NEW YORK, January 14, 1893

Iron—American Pig—We quote standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $15 to $15.50 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.25 to $13 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20 for Eglington.

Antimony—The market is easy and quiet. We quote L. X., 10½c. to 11¾c.; Cookson's, 10¾c to 10¾c.; Hallett's, 10¼c. to 10½c., and U. S. French Star, 11c.

Copper—The market is weak and nominal at 12c. bid and 12¼c. asked by second hands for Lake Copper. Casting Copper is held at 11¼c. to 11½c.

Lead—There are buyers of car-loads for prompt delivery at 3.85c., while 3.90c. is asked. Business is stagnant.

Lard Oil—Prime City is quoted at 90c. to 92c.; Western on spot at 87c. to 88c.

Spelter—The nearest approach to business is 4.20c for Pittsburgh delivery. The market here is nominal at 4.35c. to 4.40c.

Tin—The market is unsettled; sales have been made at 19.60c. to 19.80c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Exp'd mech. draftsman, designer, wants situation. Address Box 90, AMERICAN MACHINIST.

Wanted—A man thor'ly familiar with the construct'n & manuf'e of injectors. B. B., AM. MACH.

Wanted—Salesmen on commission, to push a special line of mach'y. "Kirk," care of AM. MACH.

Young mechanical draftsman, exp'd in steam engine work, desires situation. Box 80, AM. MACH.

Position wanted by exp'd designer & draftsman; technical educat'n & shop exp. Box 81, AM. MACH.

An exp'd & accurate draftsman wants position; has good exp. in superintend'g. Box 372, AM. MACH.

Draftsman familiar with machine tools, jigs, fixtures, etc., desires position. H. M., AM. MACHINIST.

Wanted—Two draftsmen for detailing locomotive drawings; no designing; must be quick, accurate & neat; state exp., also sal'y req'd. Box 89, AM. MACH.

Wanted—Position by a successful foreman, mach. tools, eng's, heavy and general work; good manager; up in modern shop practice. Box 88, AM. MACH.

Draftsman on pump and general machinery wants position as assistant on engine work. Address Practical, Box 83, AMERICAN MACHINIST.

Wanted—A first-class tool maker, familiar with punch and die work; good wages; steady job to right man. Box 92, AMERICAN MACHINIST.

A young technical graduate, with experience as draftsman, and who is at present in charge of a large foundry and erecting shop, desires a change. Box 94, AMERICAN MACHINIST.

Position Wanted—Technical training, 12 years' exp. as draftsman, pattern maker, machinist; good designer & can make estimates. A. L. Bowen, 207 McIndoe St., Wausau, Wis.

Wanted—Department foreman, used to small machine work; must be competent and a good manager. Address, stating experience, and wages expected, X, Box 85, AMERICAN MACHINIST.

Wanted—Situation—Have had experience drafting, designing, wood working machinery, stationary and marine engines, and erecting and testing steam plants. Address Box 87, AM. MACHINIST.

Wanted—General foreman in machine shop, by firm manufacturing single and duplex steam pumps; none but experienced man wanted. Address by letter, stating age, experience, references, and salary expected, C. B., Du Quoin, Ill.

Wanted—At once, by the Webster Mfg. Co., a number of first-class tool makers on fine work. Apply at once, stating experience in full, wages expected, and earliest date of commencement, Chas. E. Davis, Chief Eng'r Webster Mfg. Co., Chicago, Ill.

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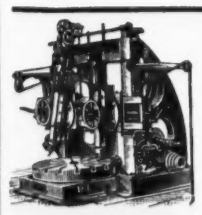

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A 1st-class mech'l draftsman, 6 years' exp., would like posi'n; N. Y. City pref'd; is familiar with small, automatic, & interchang'e work. Box 93, AM. MACH.

Wanted—3 competent machinists and 2 good molders for dry and green sand molding in shop in western Pennsylvania; must be of good habits and reliable; to suitable men good wages will be paid, and a steady position offered. Address Mechanic, care AMERICAN MACHINIST.

Mechanical engineer—first-class draftsman, designer of special mach'y for many purposes, accustomed to overseeing drawing room, shop, and field work, and especially qualified in mak'g tools for the economical product'n of parts in large quantities—wants change of position. Forethought, AM. MACH.

Wanted—A live, experienced salesman to sell engines, boilers, and transmission appliances in New York City and adjacent towns; applicants must have had previous experience in selling, or their replies will not be considered. Address Engine, Box 86, AMERICAN MACHINIST.

Wanted—Mech'l draftsman, who has had exp. on fine mach'y, small tools & fixtures, to produce accurate work; must be a good mathemat'n, thor'h & accurate in all his work; others will please not apply; please state age, experience, salary wanted, and references. Box 91, AMERICAN MACHINIST.

Wanted—A competent, energetic man as foreman or assistant sup't of machine works mfg. high grade engines, & doing a general business; must be competent to handle 50 men to best advantage, well up in modern shop practice, an educated mechanic and good draftsman preferred; state age, exp., nationality, and salary expected. W. F., AM. MACH.

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1 30 in. x 30 in. x 8 ft. Hewes & Phillips, Spiral Geared, one head on rail, very fine modern Tool. Good as new
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1 24 in. x 24 in. x 5 ft. Whitcomb Planer. Good order

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1 4 in. Hubbert & Rogers Cutting Off Machine. A1 condition
1 20 in. Prentice Bros. Drill, Wheel Feed, with Chuck. Good order
1 20 in. Reed Drill, Lever Feed, with Chuck. Good as new
1 3 Spindle Barnes Drill Press. Good as new
1 No 1 2-Spindle Garvin Drill. Good as new
1 No. 2 4-Spindle Garvin Drill. Good as new
1 No. 3 4-Spindle Garvin Drill. Good as new
1 No. 2 Brown & Sharpe Screw Machine, Automatic Chuck and Wire Feed. A1 condition
1 15 in. x 5 ft Hendey Turret Lathe. Good order
1 15 in. x 5 ft. Jones & Lamson Turret Lathe, with 3 jaw Universal Chuck. Good as new
1 No. 2 Garvin Power Miller, Swivel Vise and Arbor Good as new
1 No. 4 Garvin Miller, Arm, Vise and Arbor. A1 condition
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36 in. x 38 in. x 8 ft. do Powell A1.
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25 in. x 24 in. x 5 ft. do 1 do
22 in. x 21 in. x 5 ft. do 1 do
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30 in. x 28 ft. D. W. Pond Shafting Lathe.
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26 in. x 12, 14, 16, 18 ft. do do do do
21 in. x 10, 12 ft. do do do do
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16 in. x 6 & 8 ft. do do do do do
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Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Gang & Co., Cincinnati, O.

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Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

To Rent—Foundry in New England town, well equipped, conveniently located; machine and pat. tern shop in operation adjoining. W., 2, AM. MACH.

For Sale, Cheap—Second-hand Baldwin hand planer, planes 7"x7½"x40", with chuck and index centers. Wm. W. Tracy, Pittsfield, Mass.

For Sale—Iron Planer (new) planes 8'x24"x22". $375. Patterns for Iron Planer, Wood Planers, Parallel Vises, etc., cheap. S. E., AM. MACHINIST.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R.I.

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15 in. x 6 ft. do do do Lathe & Morse.
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20 in. x 18 ft. do do and Chuck, do Lathe & Morse.
22 in. x 12 ft. do do Fitchburg.
24 in. x 13 ft. do do do
27 in. x 12 ft. do do do
27 in. x 12 ft. do do do
35 in. x 14 ft. do do do
50 in. x 18 ft. do do Triple Geared. do

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42 in. x 9 ft. do do do Hewes & Phillips.
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8 in. Stroke, Crank Motion. Gould.
9 in. do do do Extra Power. Hewes & Phillips.
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15 in. do Friction Style. Imp. Tilting Table. Hendey.
15 in do Crank Motion, with all improvements
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20 in. Swing with Wheel Feed. Davis.
24 in. do Back Geared and Auto. Feed. Ames.
30 in. do do do do Fitchburg.
Radial Drill, 6 ft. Arm, complete. do

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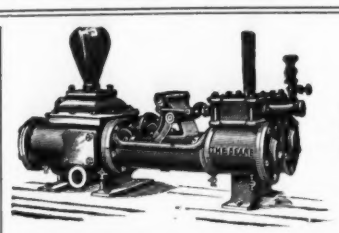

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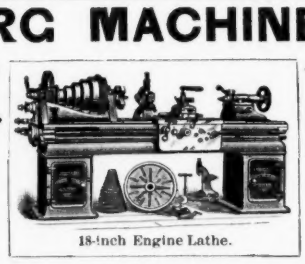

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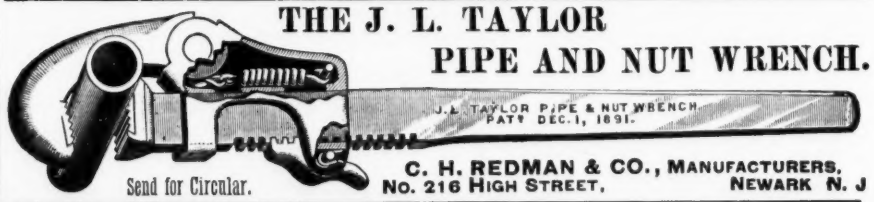

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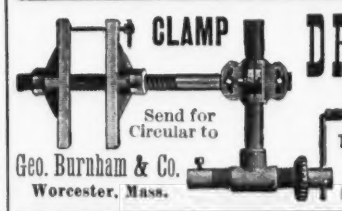

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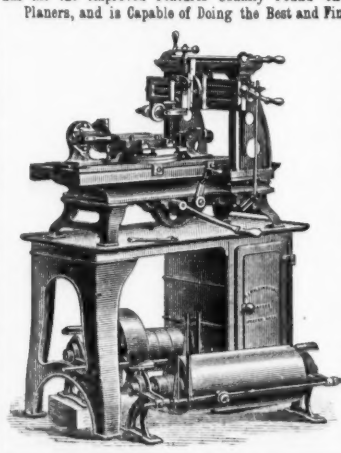

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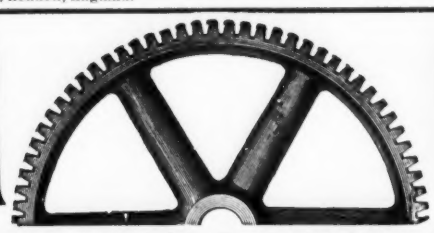

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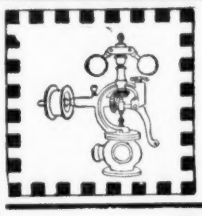

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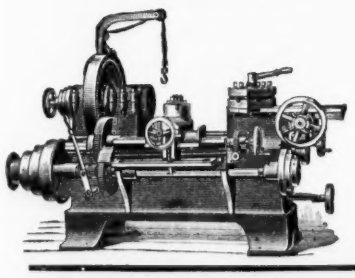

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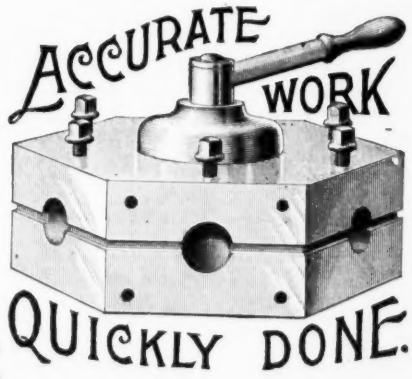

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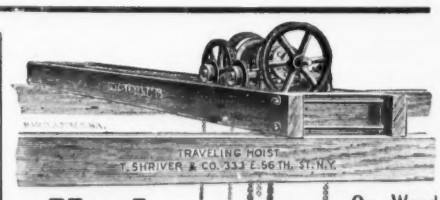

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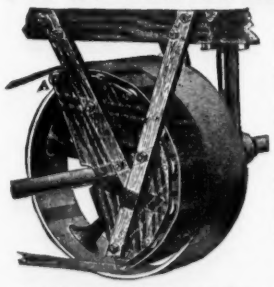

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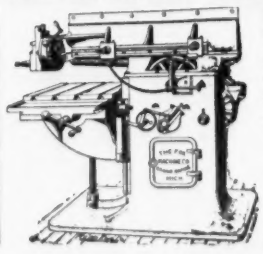

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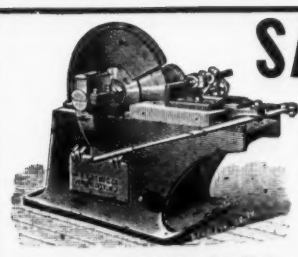

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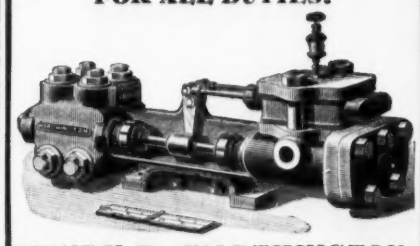

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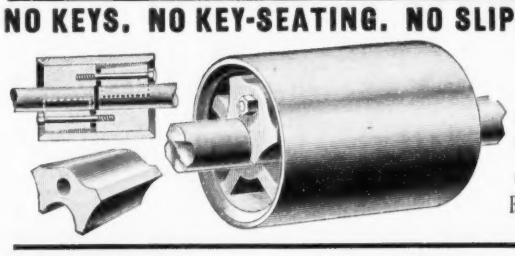

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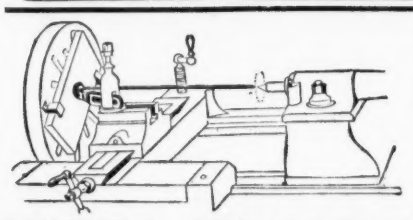

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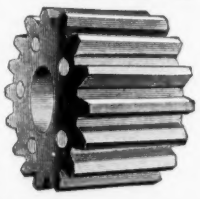

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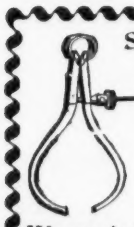

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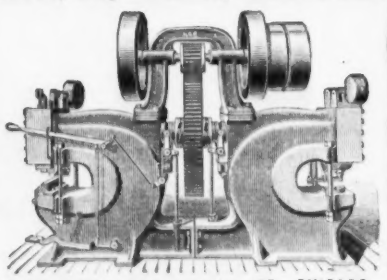

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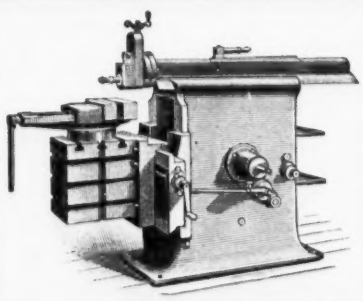

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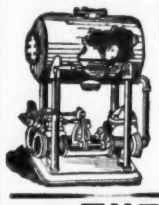

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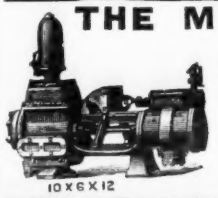

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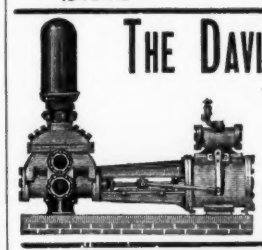

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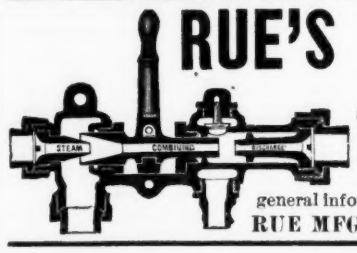

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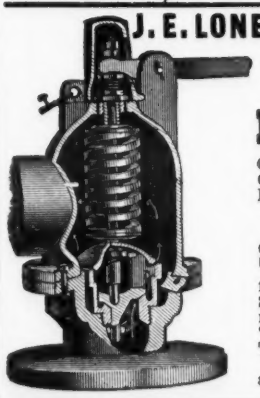

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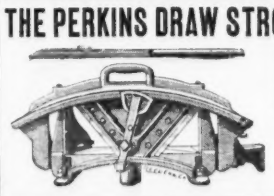

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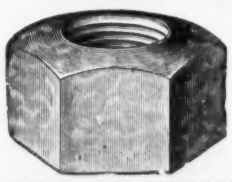

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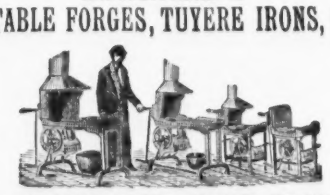

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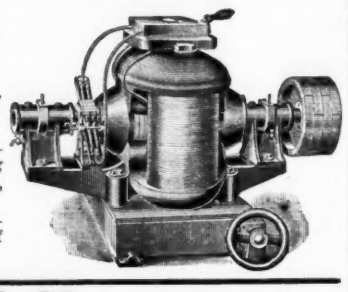

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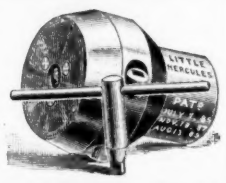

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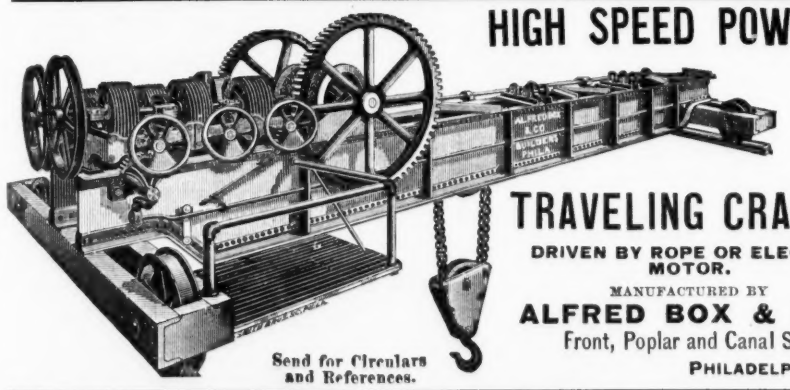

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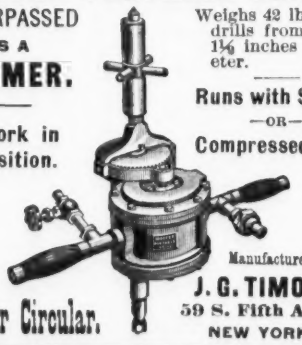

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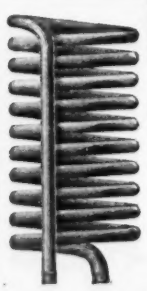

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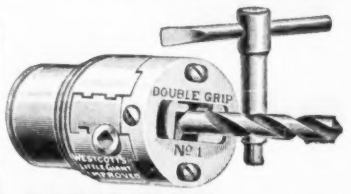
3	6 "	0 to 1½ inch.
4	6½ "	0 to 2 "
5	7 "	⅝ to 2⅝ "



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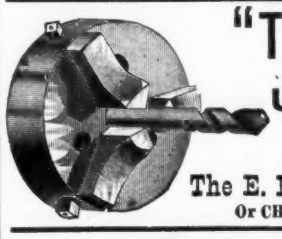

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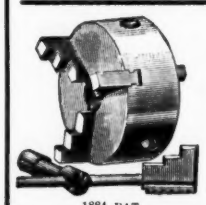

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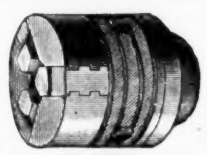

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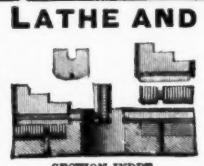

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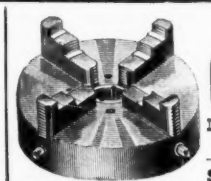

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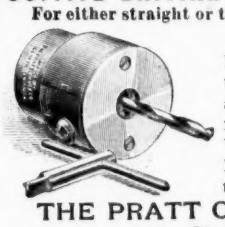

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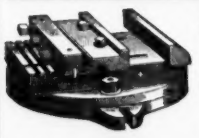

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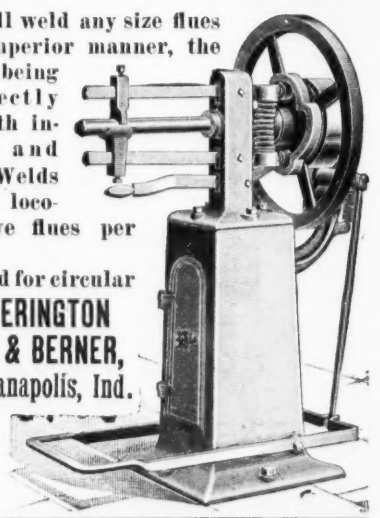

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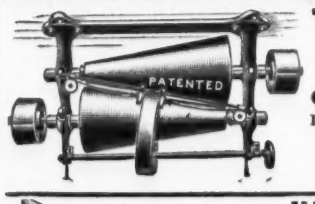

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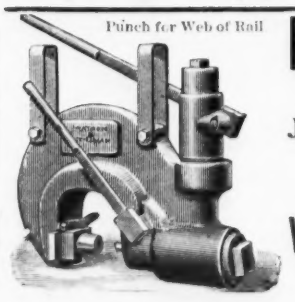

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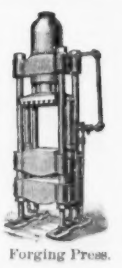

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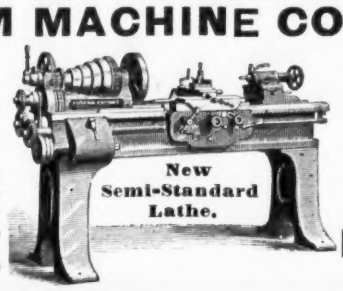

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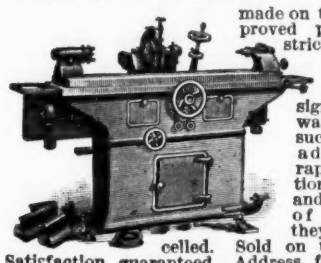

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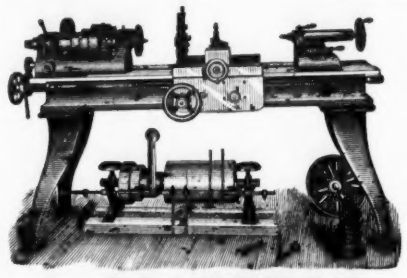

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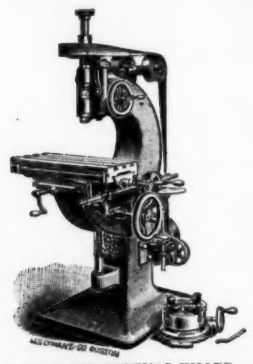

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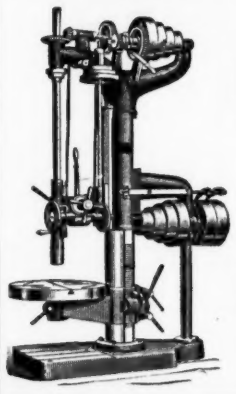

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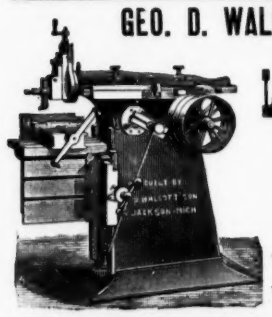

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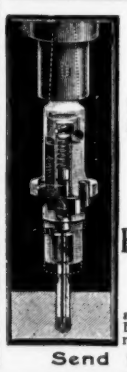

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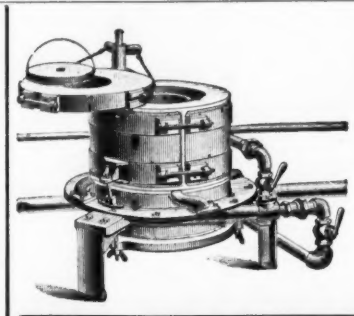

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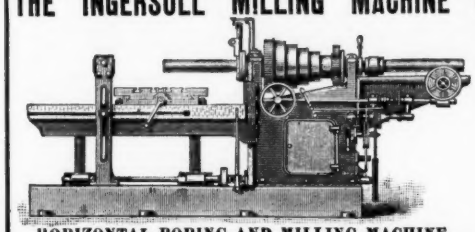

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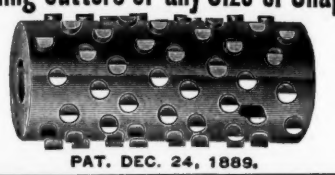

PAT. DEC. 24, 1889.

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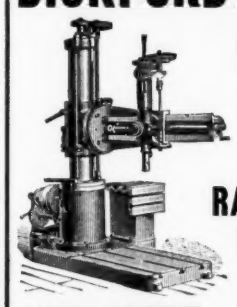

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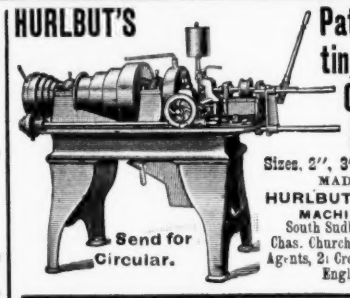

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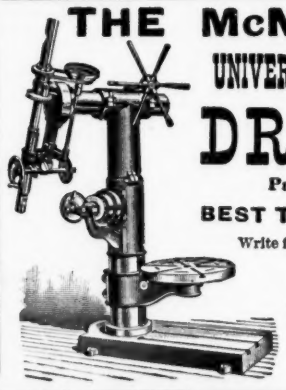

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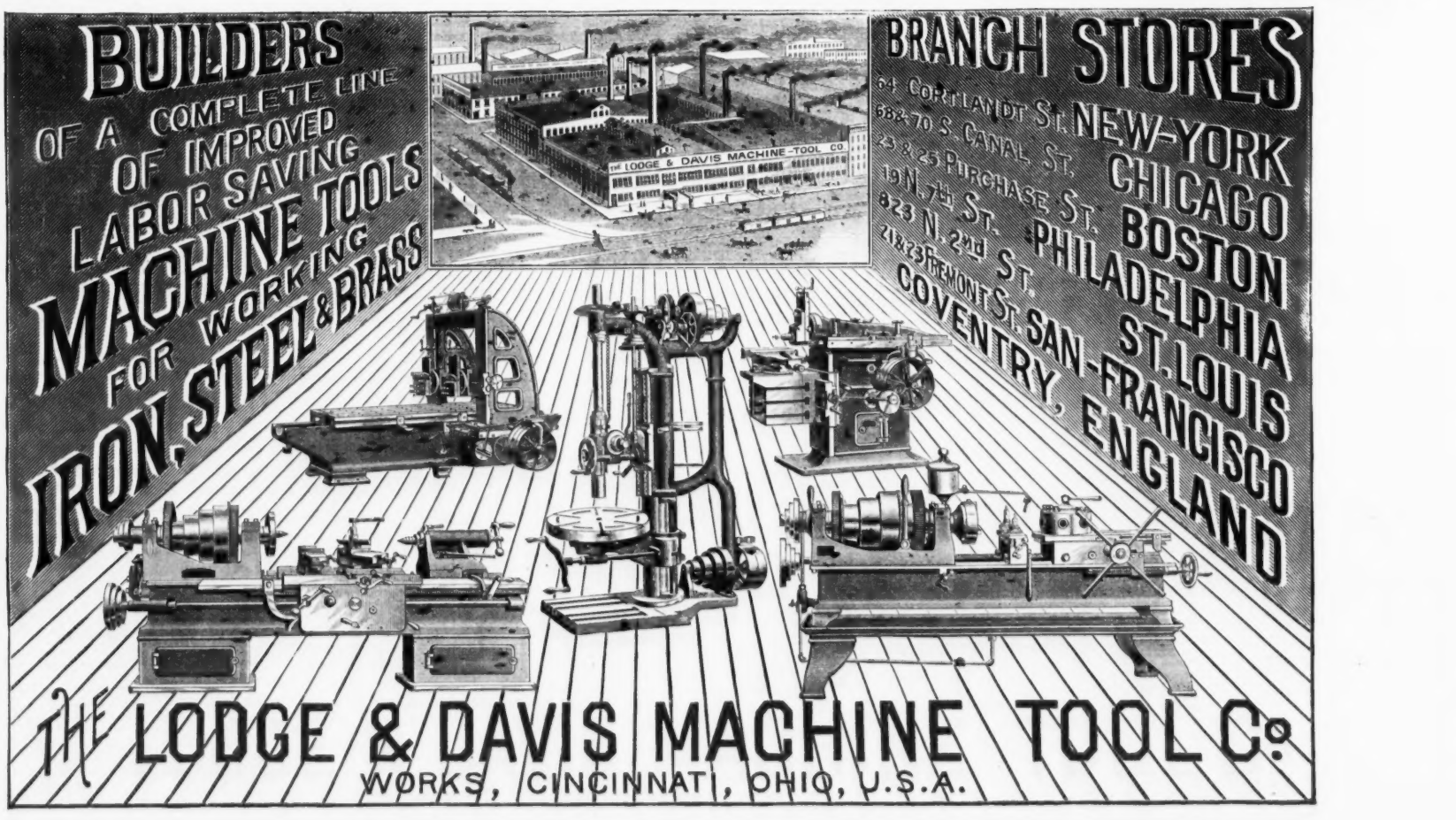

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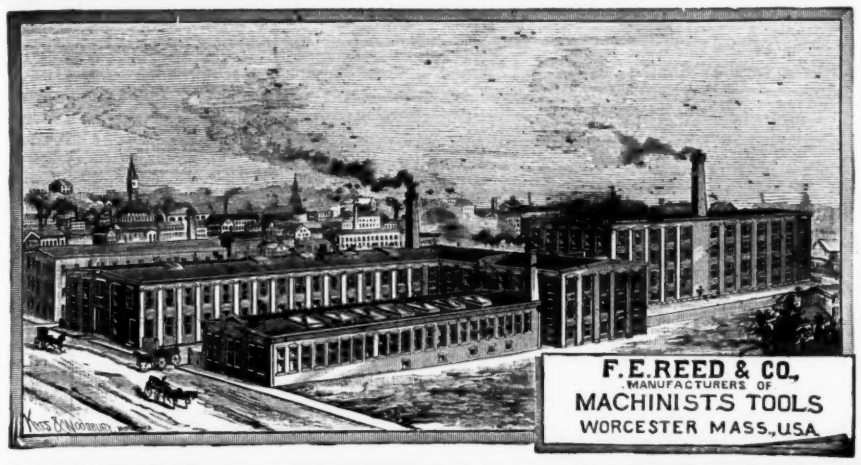

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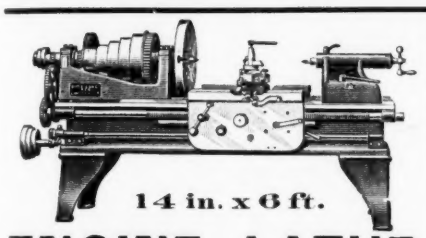

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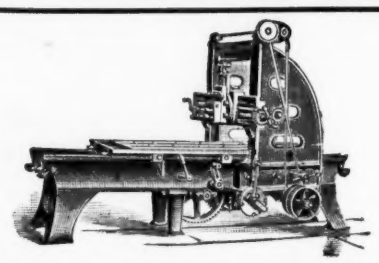

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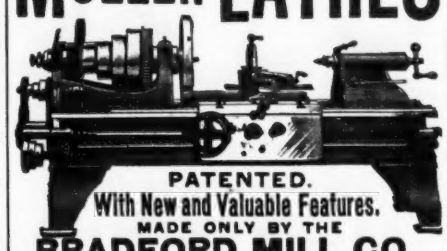

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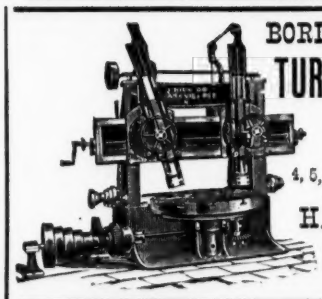

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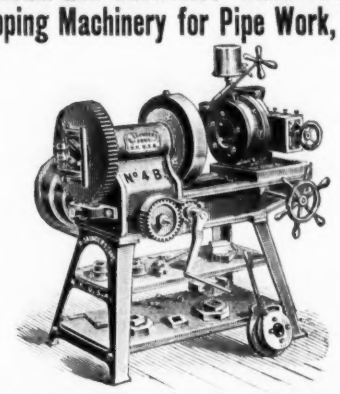

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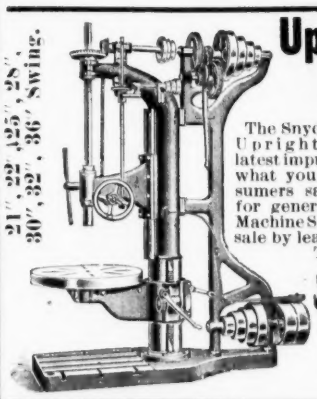

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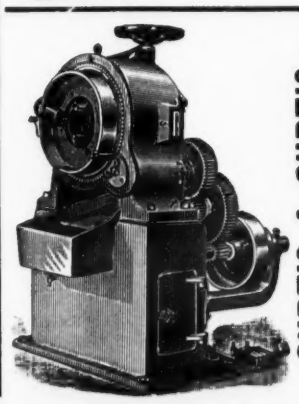

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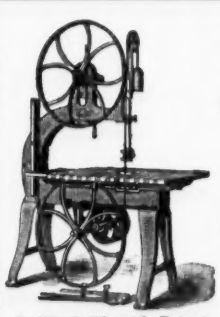

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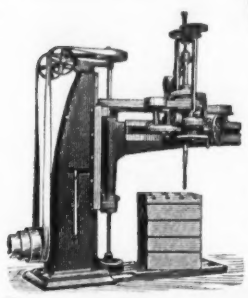

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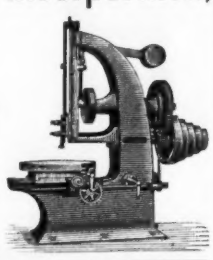

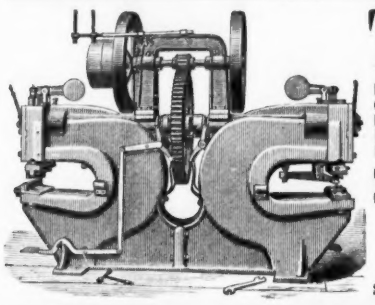

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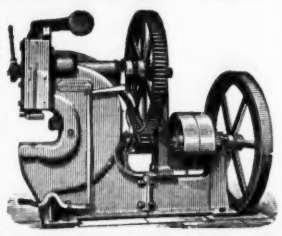

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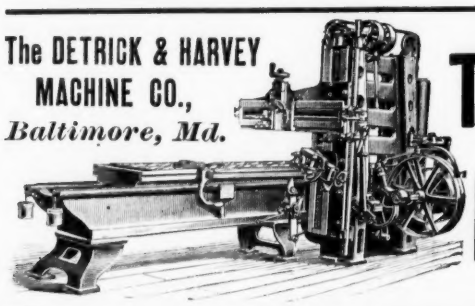

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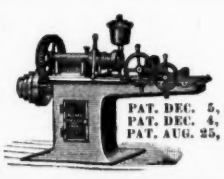
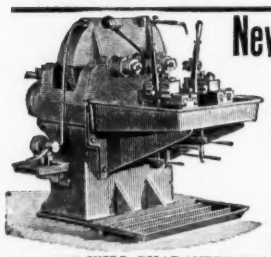


PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.



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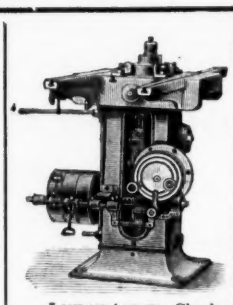

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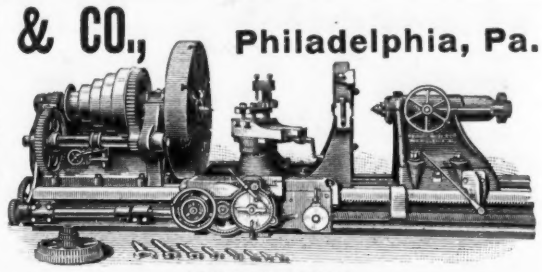

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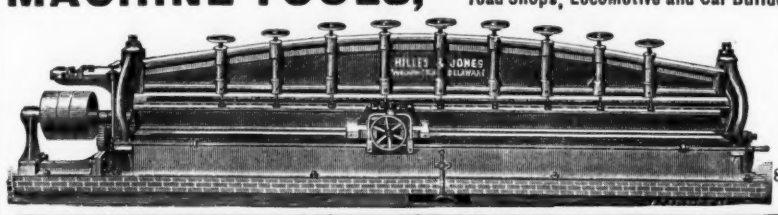

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Eight Sizes.
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Will cut through 4-foot hub, through 5-inch hole. Our new centering chuck and setting attachment the work can be set exactly, without the use of a scale or rule. Our new binding attachment saves three-fourths of the time used on any other machine for binding work on. Our machine will cut a key-way and make a key to fit it.
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TRANSMISSION MACHINERY
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THE ERIE KEY-SEATING MACHINE.
MANUFACTURED BY
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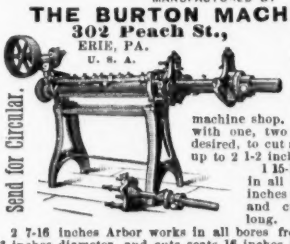

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With an attachment for the purpose seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.
If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.

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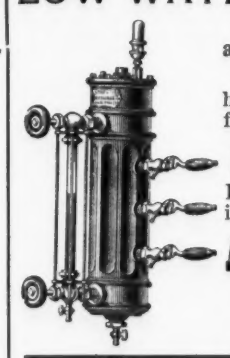

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ASHLEY'S ALARM.
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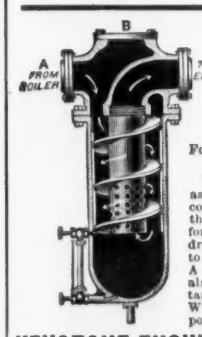
Agents wanted in every State.



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For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
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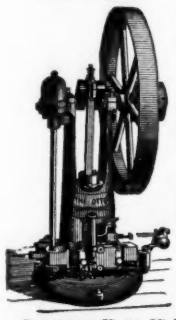

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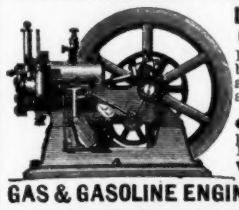

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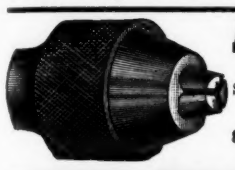

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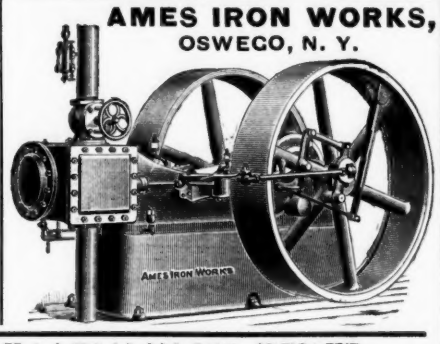

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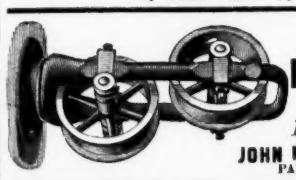

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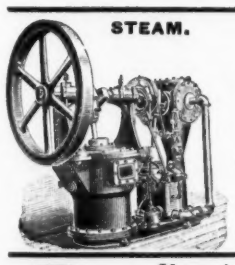

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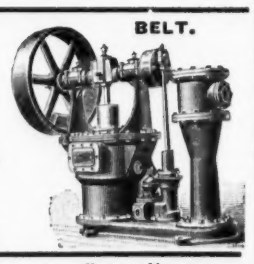

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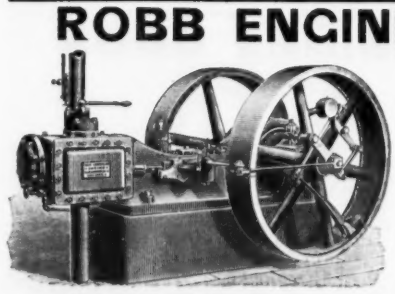

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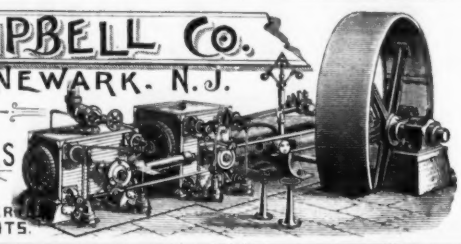

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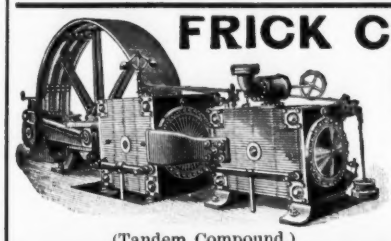

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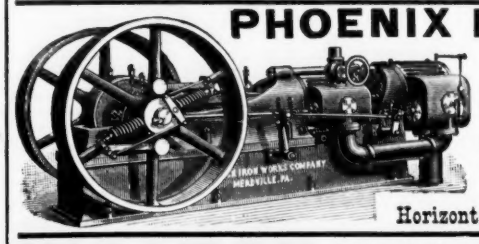

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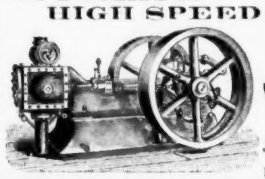

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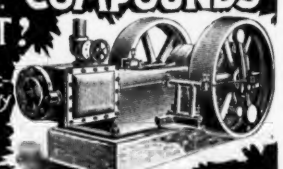

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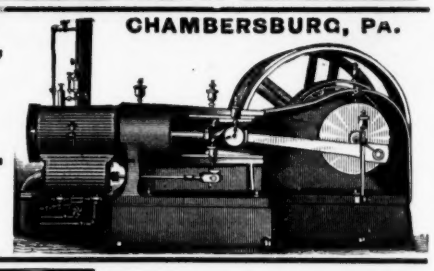

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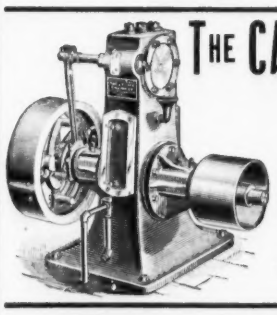

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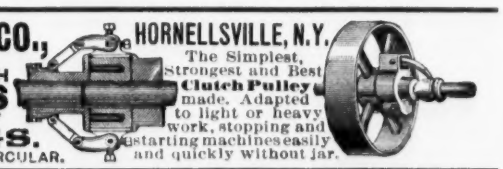

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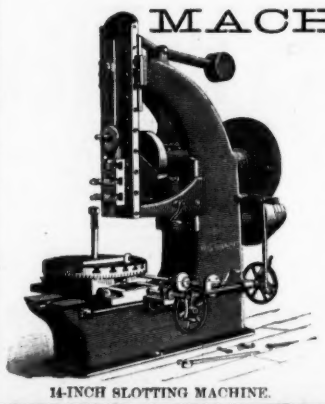

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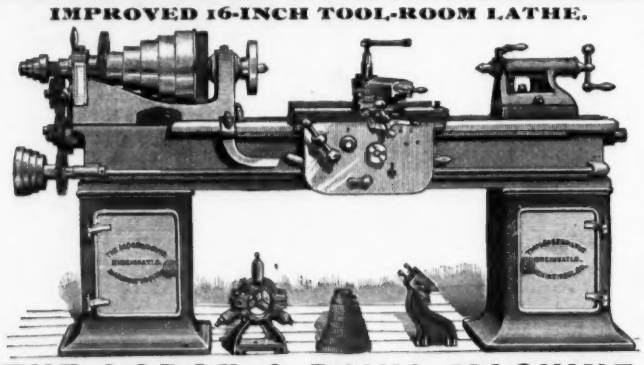

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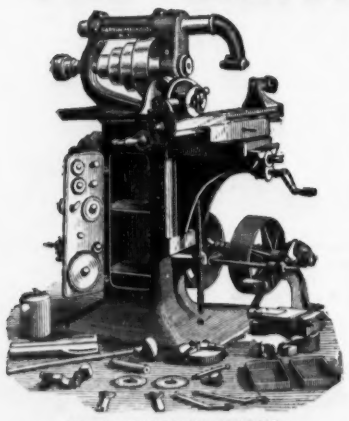

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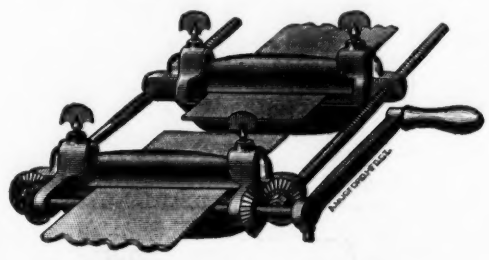

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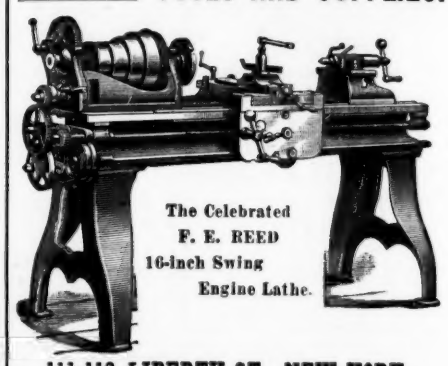

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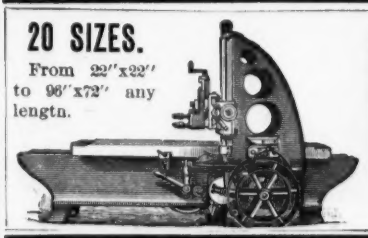

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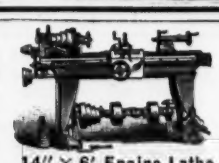

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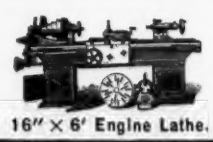

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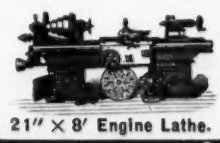

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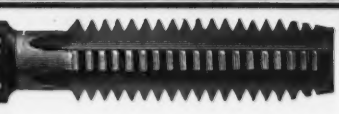

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